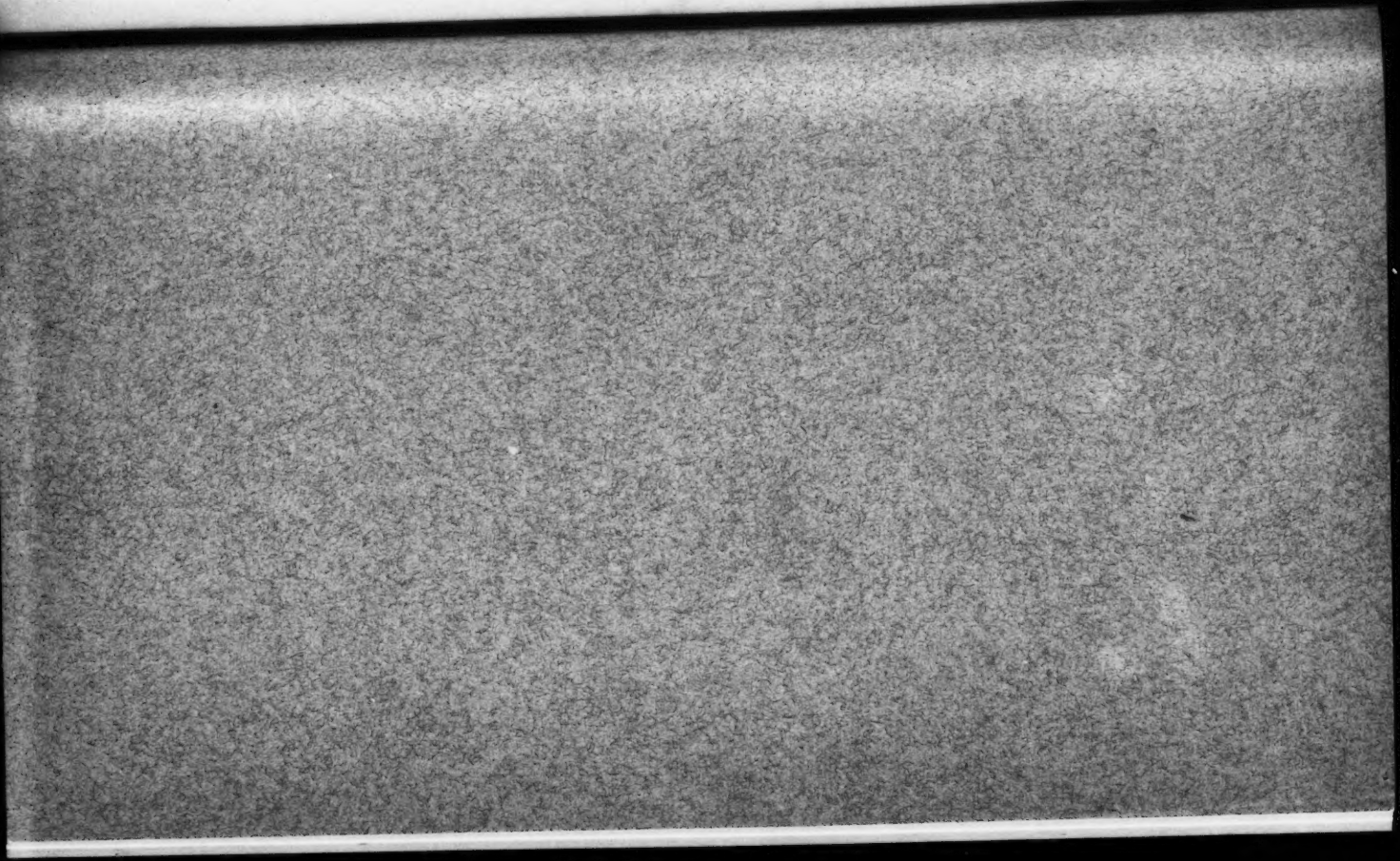
PROCEEDINGS.

American Fisheries Society.

1897.



MINUTES

OF THE

AMERICAN

FISHERIES SOCIETY

AT ITS

TWENTY-SIXTH ANNUAL MEETING

HELD AT THE RUSSELL HOUSE, DETROIT, MICHIGAN,
ON THE 17TH, 18TH AND 19TH DAYS
OF JUNE, 1897.

SPEAKER PRINTING COMPANY,
DETROIT.

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PROCEEDINGS OF AMERICAN FISHERIES SOCIETY AT ITS REGULAR MEETING HELD AT THE RUSSELL HOUSE, DETROIT, MICH., JUNE 17, 18 AND 19, 1897.

FIRST DAY'S PROCEEDINGS.

The Society was called to order by the President, Mr. Herschel Whitaker, at 10 o'clock a. m., June 17th, and the following members were found to be present:

J. E. Gunckel, Ohio; H. W. Davis, Michigan; H. A. Sherwin, Ohio; Prof. E. A. Birge, Wisconsin; Seymour Bower, Michigan; J. C. Parker, Michigan; W. J. Hunsaker, Michigan; Geo. F. Peabody, Wisconsin; F. N. Clark, Michigan; W. L. May, Nebraska; F. B. Dickerson, Michigan; Edwin E. Bryant, Wisconsin; Currie G. Bell, Wisconsin; W. D. Tomlin, Minnesota; James Nevin, Wisconsin; Henry Russel, Michigan; Herschel Whitaker, Michigan; Geo. B. Davis, Michigan; J. W. Titcomb, Vermont; J. J. Stranahan, Ohio; W. P. Manton, Michigan; Hoyt Post, Michigan; Bryant Walker, Michigan; John Bissell, Michigan; Jas. A. Dale, Pennsylvania.

The President: Gentlemen of the American Fisheries Society: I am glad to welcome you here to the city to our Twenty-sixth Annual Meeting. We are laboring under a little disadvantage this morning from the fact we haven't the report of the Secretary. At the last moment I received a communication from him saying that a business engagement would prevent his coming, but that he would send on his report and the papers connected with his office. Those have not yet been received. We are also unfortunate in not having our Treasurer with us. He has forwarded me, however, his report, his vouchers, and all papers in connection with his office, which will be submitted at the proper time and referred to a committee.

The asparagus has sprouted, gentlemen, green peaches are in the market, life is no longer a burden, the legislatures have adjourned, and there is a prospect that Congress will do the same soon, and I congratulate you upon the renewed chances of success in the country for these reasons. I hope that the meeting of the American Fisheries Society will be productive of much good to the participants, and that the papers will be as instructive as they have been in the past.

It becomes my pleasure to introduce to you, on behalf of the gentlemen anglers of Detroit who are to entertain us during your stay here, a gentleman who, though old in experience, is not old in years, and who came to the realization after years of activity, that there were other things in life good for men to know besides business. He has developed into one of our most accomplished anglers and it is unnecessary for me to say he is a most accomplished gentleman. He has left the small streams and brook trout as little side issues, and goes to the salmon streams for his sport. I have great pleasure in introducing to you Mr. Henry Russel, of Detroit, who will speak on behalf of the anglers of the city.

Mr. Russel: Gentlemen, it is difficult for me to make the few formal remarks which I am expected to make after the glowing introduction of my friend Whitaker, but it seems to me in the few words of welcome I can give you I can congratulate you that you have no secretary or treasurer present. Those two offices seem to smack a little too much of business. And if you can dispense with them at this meeting and during your visit to our city, and if you will occupy your thought and attention with other things which we will endeavor to spread before you, I do not know but your meeting will be all the more profitable.

Your President, and my friend, in whose great knowledge of fish and in whose skill as an angler we all take pride, notified me he would ask me to speak in behalf of the friends of angling and to welcome you to our city, and I assure you it is a great privilege to lay aside business cares, for the time at any rate, and extend to you our hospitality. To some of you whose names are household words in Michigan, I need not say anything in the way of welcome, for you know you are always welcome. Now, Mr. Herschel "Whitefish" Whitaker, as he is sometimes known—and I want to explain at the outset in respect to that, that he is so full of fishing lore, he has had so many experiences that many of us believe he is the man that took down the shorthand notes of St. Anthony's sermon on fishes—we know he has a shorthand way of casting, and he brings to bear his great skill whenever he strikes a fish—Mr. Whitaker has not come to me in any way as a lawyer, railroad man, banker, or manufacturer, nor even as a representative business man to request me to address you this morning, and I wish to say to you I want you to

forget business, for I am the Chairman of the Fontanalis Club, and I come before you to-day hoping that all my business delinquencies will be forgotten.

You come to the Land of Lakes, as the name of Michigan implies. The inland lakes and streams are more numerous in Michigan than in any other State in the Union. The State, as you are aware, is composed of two peninsulas, surrounded by lakes which are seas in their extent. Every variety of fresh water fish constitute the denizens of these inland waters, and it is a curious thing, not only in the experience of boyhood, but of manhood that every boy in Michigan all through the interior of the State grows up with a knowledge of the habits and is able to distinguish all the different sorts of fish. In this community, in Michigan, fish has been so important an article of food, and there has been so much of a tendency to turn to fishing as a sport that the people in our community, far more than those of any other place, are able to know all the varieties and the habits and character of our fish, our black bass and whitefish and trout, and we have here what distinguishes us above other places, the rare and gentle grayling.

Our State in the past has not been unmindful of the value of this, and both from the point of sport, and from the commercial point of view the state has fostered these fertile waters. It is true our state commission has, like all the rest of the industries, had a contest, but notwithstanding this they are "still in the ring." But we know this, that in the state of Michigan with the results of the work of our commission before us and the feeling of the state of Michigan towards both the cultivation and propagation of fish for sport and for food, there will be only a temporary abatement in the prosecution of the work of the distribution of fish and the development of our fisheries. They have done so much and the work has been so well done that we have no fear of the future. The greed of the destroying fishermen will overreach itself and I believe I speak with a knowledge of state affairs in stating that while a false economy may for a time restrain the work of the Fish Commission, there will be a change of sentiment pretty soon, and there will be a sowing upon the waters of this state which will be sure to bring forth a good harvest.

Now, gentlemen, that you are here we want you, as I have already intimated, to lay aside business as much as possible, we will endeavor to persuade you to do that, and we only ask

you to study the object lessons we shall give you. We propose this afternoon to get a couple of "fishing smacks" and take you to the great and famous bass grounds of this country, the Lake St. Clair fishing and shooting grounds; and from there, after supper, we will come down in the evening to the city, and to-morrow the town is yours and I may add the fullness thereof as well. (Applause.) To-morrow a "fish car!" train will be made up by the railroad and you will be hauled to Paris, and there you will spend the day and we trust you will come back in "fair round belly with good brook trout lined." When you return from there, and not until after you return, you are expected to think of business.

I read an anecdote the other day of Dr. Beale, the Bishop of Durham, which seems to me full of good sense. When writing one of his most important works he was asked when it would be finished, he replied, with great good humor and perfect sincerity, "Oh, I will undertake to take hold of that and push it to an accomplishment as rapidly as possible after the fly fishing season is over." (Applause.)

The Chair: It will become necessary for the Society to elect a temporary secretary and treasurer. The chair is prepared to entertain a motion to that end. Will some member make the motion?

Dr. Parker: I move that Mr. May, of Omaha, Nebraska, be elected Secretary.

The motion was supported and unanimously carried.

On motion, duly seconded, Mr. Freeman B. Dickerson was elected Treasurer pro tem.

The Chair: Gentlemen, you are probably as well aware as I am, that the duties of a President of this Society begin and end practically with the meeting. During the interim between the meetings there is little or no business to be transacted, therefore it does not become necessary for the President to submit a voluminous report.

The year in fish culture has been about what it has been in former years, with perhaps the exception of the conditions in this state. Most of you are aware undoubtedly that the legislature in its unwisdom saw fit to very largely reduce the amount of money appropriated for the current expenses of the Board of Fish Commissioners of Michigan. I only refer to this here, as the matter is quite likely to come up in some shape here-

after, so this society will be informed as to what the meaning of it is, provided it should prove to be a permanent thing. It affects not alone Michigan but the standing of all our interests in fish culture, because the circumstances that surround the temporary suspension of this work, which perhaps may become permanent, in my own judgment affects every single commission in existence in this country to-day, and to that extent the other commissions are interested in this subject. It is a question, I may say, without going into the matter very fully, which surrounds the success of fish planting generally. It is a question of the proper protection of fish and in every sense affects the question of fish planting. A proper administration and application of public funds should have in view the idea that the work done shall be followed with good results. That in a nutshell is the question, and I say it is likely to come before you later on and it seems to me it is a matter that ought to interest us all.

It will be necessary for us to make some recognition of the death of two very prominent members of this organization in the last year, the death of each of whom will cause vacancies in this society that it will be hard to fill. It falls with peculiar solemnity upon those of us who have long been members of this association and who had come to know such men as Mr. Ford, of Pennsylvania, and Mr. Fitzhugh, of Michigan. Mr. Ford was one of the foremost men in the promotion of the interests of fish culture in his own State. He was one of the men who contributed most largely to the success of this Association. He was a conscientious gentleman, an expert fish culturist, a man of broad views and a man who has given this society a standing in his own community and wherever he was known. It will become necessary for us to take some steps to properly recognize his death. I understand the gentleman from Pennsylvania has a memorial which will be offered at the proper time.

We have also lost another member who was one of the finest characters I have ever known. He was a Michigan man; he was a gentleman angler, a man whose heart was as gentle and as good as a woman's, a man whom it was a plesaure to know as a personal friend, a man who "wore his heart upon his sleeve" for his friends, a gentleman who was connected more directly than any other man in the United States with the identification of what is now known as the Michigan grayling, Mr. D. H. Fitzhugh, of Bay City. It was my pleasure to know him intimately, and his death came to me almost as a personal bereavement. I hope that a proper recognition will be made when the time comes

of the death of these two gentlemen. There are possibly others whose decease has not come to my knowledge, and if so it will be proper to take some action upon those.

During the last year there have been, as will be revealed by the report of the Secretary, some resignations, and among them one to which I wish to call your attention and I would suggest that proper action be taken upon the same. Mr. Fred. Mather, one of the founders of the American Fisheries Society, a man who has probably contributed as largely to the success and interest of this Association as any man in this country, as most of you are aware, terminated his connection with the New York Commission something like two years ago. Certain personal reasons led Mr. Mather to feel that he should withdraw from the Society. My own judgment, and I believe that view will be sanctioned by every gentleman here who knows him, is that he is justly entitled to become a life member of this Association for what he has done for it. I would recommend in my suggestions to you that action be taken to this end, as it seems to me an eminently proper one.

The question will come up with reference to the time and place of meeting, and it is customary to appoint at the first session committees on the place of meeting and on nomination of officers. That will be in order pretty soon.

I think Mr. Russel has outlined to you what the programme is here. At 2 o'clock, city time, we are expected to leave the foot of Third street on two private yachts, kindly donated by Mr. Smith and Mr. McMillan.

I think an opportunity had better be offered at this point for the presentation of names for membership, as has been the custom, and if any of you gentlemen have the names of persons to suggest now is the time and the Chair will be glad to hear them. I myself suggest the name of Dr. W. P. Manton, of Detroit. I have another list of proposed members which I have left at the office, but will bring in later. I also propose the name of Mr. Henry Russel, of Detroit.

I think the first thing in order will be the appointment of a committee on membership to pass upon candidates. The constitution requires they shall be elected by a two-thirds vote. I think it is hardly necessary for a motion, and I will appoint as a committee on nominations for membership Dr. J. C. Parker, of Grand Rapids; Mr. Geo. Peabody, of Vermont, and Mr. F. N. Clark, of Northville. The Secretary will give them the names of candidates and they will report at once.

While we are waiting for that committee I want to say one thing further which should have been in my verbal report of the proceedings of last year. At the meeting of the Association last year the following resolution was adopted:

"Resolved, That the President appoint a committee of one member from each of the seaboard States, to whom the subject of Mr. Huntington's paper shall be referred with power."

Mr. Huntington's paper related to the protection of fish in the ocean along the seaboard States, and a resolution by Mr. Dickerson was offered in connection with it providing for the appointment of a like committee from the lake States. I subsequently wrote Mr. Huntington for suggestions as to who the committee should be from the seaboard. He gave me the names of several gentlemen who were not members of the Society. While I had no particular objection to appointing these men, and have no doubt they would have acted cheerfully, at the same time I did not know what authority this Society had to nominate men to act upon a committee when they are not members of the Society, and I therefore declined to make those appointments. I think no injury has been worked, but it seems to me that the Society could not with any proper sense of dignity, nominate men on committees to act for it over whom they had no power even of membership, and after thinking the matter over I came to the conclusion it was a matter that had not been considered in that light at the time the resolution was offered, and I therefore made no appointments. That is the explanation of my non-action in that matter.

We are a little embarrassed by the Secretary's report not being here. I had supposed he had made up a list of papers to be read at this meeting, but if he has, it has not come to hand, and I think it is best now for the Secretary to take down a list of the papers and of the writers who are ready to read papers at this meeting and I hope that those who have papers will announce the subject and then we shall have it on the program for to-morrow. Prof. Birge, I believe you have a paper?

Prof. Birge: I had expected to use about five or ten minutes on the subject of the "Vertical Distribution of Plants and Animals in the Inland Lakes."

Dr. Parker: The following names have been examined by your committee. We find them satisfactory and the committee is unanimous in recommending their election.

The following persons were then unanimously elected members of the Society:

Henry Russel, Detroit; Dr. W. P. Manton, Detroit; W. J. Hunsaker, Detroit; E. E. Bryant, Madison, Wis.; Prof. E. A. Birge, Madison, Wis.; Currie G. Bell, Bayfield, Wis.; Dr. A. W. Hoyt, 243 Wabash avenue, Chicago, Ill.; Geo. B. Davis, Utica, Mich.; W. J. O'Brien, South Bend, Neb.; Henry Sykes, Bayfield, Wis.

On motion of Mr. Dale, Mr. Fred. Mather was elected a life member of the American Fisheries Society.

Dr. Parker: I would like to ask if there is such a provision as that in the constitution?

The Chair: There is.

Dr. Parker: What does it carry with it?

The Chair: It carries with it the remission of dues. That will be covered by making him an honorary member.

Dr. Parker: What is the standing of such a member? I would like to have Mr. Mather have a voice in the Society.

The Chair: There is no reference to that in the constitution whatever, but it has been the custom to elect persons honorary members and that implies they are on the same footing as to participation in the proceedings as active members.

Mr. Dale: I move that a committee be appointed to make some recognition of the death of members of the Society and to report to-morrow morning.

The motion was seconded and unanimously adopted.

Dr. Parker: I move that a committee of three be appointed to select and recommend to the Society a suitable place for our next meeting.

The motion was seconded and unanimously adopted.

The Chair: I will appoint on the committee to take cognizance of the death of members Mr. Dale, Dr. Parker and Mr. H. W. Davis.

I will announce the committee to select the place of next meeting in the morning.

Mr. Peabody: I move that a committee of five be appointed on nomination of candidates for officers of the American Fish-

eries Society for the ensuing year, to report at to-morrow's session.

The motion was seconded and unanimously adopted.

A letter from the Treasurer, Mr. L. D. Huntington, was then read regretting his enforced absence from the meeting on account of illness in his family.

Letters of regret at not being able to be present at the meeting were read from H. B. Mansfield, Dr. Bushrod W. James, Bernard L. Douredore, A. N. Cheney and others.

The Chair: If you are ready I think we will have the report of the Treasurer read. The Acting Treasurer will read the report.

The report was as follows:

TREASURER'S REPORT FOR YEAR 1896.

L. D. Huntington, Treasurer, in account with American Fisheries Society:

Dr.

June 20, 1896, to balance of year 1895, received from F. J. Amsden	$141 32		
June 20, 1896, dues collected by and received from same	69 00		
		$210 32	
June 15, 1897, from dues collected for the year 1896 and for years prior thereto		372 00	
			$582 32

Cr.

July 3, 1896, T. H. Bean, late Secretary	$	5 61
July 3, 1896, Humphrey, printing and stationery		6 00
July 3, 1896, T. E. Crossman, stenographer		41 00
July 23, 1896, Glens Falls Printing Co., printing and stationery		21 75
July 23, 1896, A. N. Cheney, Secretary		2 69
July, typewriting circulars		1 75
August. Humphrey, printing Treasurer's receipts		1 75
August. Typewriting circulars		1 75
March. Forest and Stream, use of cut of the Hon. E. Potter		2 50
March, A. N. Cheney, Secretary		24 85

March. Glens Falls Printing Co., printing proceedings of Society.....	131 92	
Postage	11 48	
July. Humphrey, envelopes	1 50	
		254 55
June 15, 1897, balance in hands of Treasurer.		$327 77

42 New street, New York City, June 14, 1897.

To the Members of the American Fisheries Society:

Gentlemen—I find from the Treasurer's books that it has been the custom of late years for the Treasurer to present at the annual meeting of the society a statement with balance, etc., but not a correct statement for the fiscal year, for which they were made, for the reason that a considerable amount of dues for and belonging to the then succeeding year, have been collected and credited to the year previous, to which they were due and belonged. For instance, in the statement for the year 1893 there were $138 of the dues of the year 1894 collected and credited. In the statement of 1894 there was $30 of the year 1895 dues collected and credited to 1894 statement, and bills incurred and presented for that year to the amount of $156.70 not mentioned in the statement, which were paid and charged in the year 1895 statement. The statement for the year 1893 shows a balance Cr. of $67.49, whereas the actual balance for that fiscal year was Dr. $70.51, $138 credited to 1893 were from dues of and belonging to 1894. The balance as shown for the year 1894 was Cr. $80.65, whereas the figures on the Treasurer's book for the fiscal year 1894 showed a balance Dr. of $66.29. The balance as shown by the statement for 1895 was Cr. $141.32, while the figures for the fiscal year of 1895 showed a balance of $328.02, the balance for June, 1894, having received the benefit of $186.70 belonging to the fiscal year of 1895. The statement herewith presented is for the fiscal year 1896; the receipts over expenditures being $186.45, which, added to the balance with the Treasurer at the commencement of the year of $141.32, leaves the actual balance of $327.77 now in the treasury.

Immediately after having been elected president of the society, June 12, 1895, I made an examination of the list of members as then of record on the Treasurer's book with their respective payment of dues, and took a verified copy of same; and with the assistance of Dr. Tarleton H. Bean, the then Secretary

of the Society, we on several dates during the year 1895 prepared circulars and mailed a copy of same to all members then in arrears for dues, requesting prompt remittance of same to the then Treasurer, F. J. Amsden. Since May 20, 1896, when I was chosen Treasurer of the Society, I have at various times prepared and mailed four similar circulars to those who were in arrears at the dates of sending same. I attach hereto copies of the seven circulars above referred to. The results of the circulars so sent, as well as of numerous letters and personal requests are condensed in the tabulated statement herewith attached. This statement accounts only for the 276 names that were taken from the list of members as of record on the Treasurer's book June, 1895; there having been 22 members elected in the year 1895, one of whom has since resigned. One claims that he is not now a member and one requests his name dropped from the list. There were fourteen members elected in 1896 and there are at the present time of record on the Treasurer's book agreeable to the provisions of the constitution, with dues generally paid to date about 145 members.

The amount of dues collected in 1895 was $507, $354 being for the year 1895, $147 for dues of previous year, and $6 for dues of 1896. The amount of dues collected in the year 1896 was $441, $354 being for 1896 dues, and for dues of previous years, $87. Allow me to assure you that for two years last past, one year as President and one year as Treasurer, I have used my best efforts to collect all arrearages of dues and secure a correct list of members, with results as stated.

Yours truly,

L. D. HUNTINGTON,
Treasurer.

In addition to the foregoing the Treasurer announced that the following named persons had paid all outstanding dues and had presented their resignations:

A. Mitchell, C. H. Orvis, Dr. Bashford Dean, W. C. Clark, J. A. Loring, S. R. Stone, H. D. Dean.

On motion of Mr. Dickerson the resignations were accepted.

Mr. Dickerson: I move that the report of the Treasurer be accepted, and an auditing committee of three be appointed to audit his accounts.

The motion was seconded and unanimously adopted.

The Chair: I will appoint as auditing committee Mr. Peabody, Mr. W. H. Davis and Mr. F. N. Clark.

I desire to propose the name of Senator J. L. Preston, of Lapeer, Michigan, as a member of this Society, and the name will be referred to the committee without further order and they will report at once.

The membership committee, after a brief session, reported unanimously in favor of the election of Mr. Preston and he was duly elected a member of the Association.

The Chair: I want to say a word in connection with the Treasurer's report. I am satisfied it has been a great disappointment to him not to be present. He is a devoted member of the Society, and I have had long enough experience with the Society to know that he has made a most efficient Treasurer. He has looked after the dues, he has been very careful, and his report shows we are in very fair financial condition, and it is largely owing to his efforts that it is so. I regret as much as he does that he is not here.

The name of William Osborn, of Duluth, Minnesota, was proposed by Mr. Tomlin as a member of the Society.

The committee on membership reported in favor of Mr. Osborn, and he was duly elected.

Mr. Gunckel: I desire to say a few words on the subject of which a committee has been appointed. I had a conference with Mr. Huntington before I left New York last year, and since then I have had correspondence with President McKinley and have had a conversation with him touching the subject, and he most heartily endorses anything this Society may recommend touching the protection of fish not only upon the Atlantic and Pacific coasts, but in all the inland lakes, and he assured me he would give it his personal attention. I presume after the Dingley bill has passed he will do so.

The Chair: I desire to say a few words with reference to the printed proceedings of last year. The stenographer's report was, to say the least, a very poor one, and more care should be taken in the editing of the report. I myself opposed the return of the papers to authors after they were once in the hands of the Secretary, and made a motion by which the Secretary was authorized to retain in his possession such papers as were read at the meeting. The reason for that was that if the papers were returned to the writers, through the multiplicity of their own affairs they

forget to return them to the Secretary and thus delayed the report. But my expectation was that they would have an opportunity to read and correct any extemporaneous remarks that were made. I speak for no one but myself, but there are certain things in the report, of things I said that would lead one to think that the entertainment had been too much for me. The secretary acted, perhaps, as best he could, but I dislike to be misquoted in what I say, or have senseless language imputed to me because of the inefficiency of the man who took it down. Our reports go out, not only to our own members, but they go all over the country and some go abroad, and the greatest care should be taken in their publication. It is a garbled report, so far as my own remarks were concerned at any rate, and it is too bad it should be so. A great deal of care should be taken in editing the report, particularly the discussions. Sometimes a man does not express what he means, but if he does he should be reported correctly.

Mr. Gunckle: I received several letters during the year on that same subject from members who attended the last meeting in New York, calling my attention to the remarks that they had made relating to arguments on some very important subjects, and it seems they were just the reverse of what they intended, and they wrote me that they did not think they would argue any more on any subject.

The Chair: That is it precisely.

Mr. Gunckle: And then also I noticed where they surely have misquoted, particularly the paper I read last year. There is no excuse for mistakes where you have it in black and white before you. Neither is there any excuse for having the report delayed so long as it was last year. I cannot see why this Society cannot afford to have a capable stenographer and have everything complete and let the Secretary select for publication just the things that are necessary for the advancement of the Society.

The Chair: The long delay in getting out the report has become proverbial year after year, and it does seem as if the report of this year could be gotten out promptly. If there is any value in it, it should be had in a reasonable time after the meeting.

Mr. Gunckle: Don't you think it would be well for members who submit the papers to be allowed the privilege of reading their own proof?

Mr. Dickerson: It should be sent to them in galley proof.

The Chair: And I think the Secretary, unless he receives a return of corrected proof in reasonable time should correct it according to his own judgment, and publish the report and not delay the work on account of the delinquencies of members.

Mr. Gunckle: I understand that Dr. Bean, who read a foreign paper last year, was in Europe and the Secretary had to send it over there to be corrected. I would also suggest that there be some provision made whereby the subjects of papers will be taken care of better. Now, last year in New York quite a number of gentlemen were present, and they did not report they would read papers, from the fact it takes up too much time and there is no inducement for a member to read his own paper except for the discussions that it arouses. I think there should be a provision requiring that just so many papers should be read, say five or ten, instead of depending on voluntary papers. How this should be done I will let the experienced men suggest.

Mr. Clark: It has always occurred to me that the plan suggested would be a good one; that either the officers or a committee should be appointed to arrange a plan for papers to be submitted by those interested in different subjects, papers on fish cultural matter by fish culturists, and scientific papers by scientists, and so on through, so that we would know a little something of what we are going to have. I think there should be some program made out so that we would know we would have those papers.

The Chair: I have not received any communication from the Secretary, so I cannot say how far he has gone in this matter, but I know he asked members a month ago for the titles of papers that were to be read, so I presume likely he intended to get out some sort of a program, but it has not arrived for some cause or other. It would be advisable to have a program issued in advance of the session.

Mr. Peabody: I think Mr. Clark's idea that a committee be appointed or the officers asked to solicit articles from men who are specially fitted to write articles on certain subjects is good. I quite agree with him. It seems to me, in order to be enduring we should take steps to that end. This should be a business organization. Although a certain amount of pleasure should be attached to it there should be great care exercised not to have pleasure dominate too much. Two or three days ought to be

profitably spent, a good share of the days, in the discussion of papers on subjects to advance fish culture.

The Chair: I desire to say in this connection that the president took it upon himself to address several gentlemen who he believed were able and disposed to give this Society papers on some interesting theme. Among those gentlemen were Prof. Birge, who is present and expects to read a paper, and Prof. Reighard, of the University of Michigan, who will be here with a paper of interest to-morrow. He wrote to me asking me about when his paper would be due. I fancy he is a very busy man these days, and has to husband his time, but there is no doubt he will be here. I also wrote to Prof. S. A. Forbes, of the Natural History Observatory of Illinois, who promised us a paper and intended to be here personally and read it, but on Friday last I received a communication from him saying that the legislature had laid an additional burden upon him in his work and he had another engagement which would prevent him from being here altogether, and so we are deprived of his paper. I think the suggestion is a very good one and it may crystallize perhaps into a proposition for a committee to consider the matter and report to-morrow, and then the body can act upon it as they see fit.

On motion an adjournment was then had until next day at 9 o'clock.

SECOND DAY'S PROCEEDINGS.

Friday, June 18, 1897, 9 a. m.

Chairman Whitaker: The Society will come to order. I was authorized to appoint two committees yesterday, and I will do it now, so that they can get together and confer during the course of the morning and report here at their convenience. The committee on place of meeting will be Mr. H. W. Davis, Mr. Dale and Mr. Bower.

The committee on nominations will be Mr. Peabody, Mr. Dickerson, Mr. Clark, Mr. Preston and Mr. Gunckle.

The committee on auditing the report of the Treasurer is now prepared to report. We will listen to the report.

Mr. Peabody: As chairman of the committee I would report we have found the Treasurer's accounts correct and so report them and recommend the adoption of the report.

The motion was duly seconded and the report was unanimously adopted.

Chairman Whitaker: Since the close of yesterday's meeting the report of the Secretary has come to hand, and the Secretary pro tem will read it.

The report was then read as follows:

Glens Falls, N. Y., June 14, 1897.

American Fisheries Society:

Gentlemen—I have the honor to present a brief statement of my duties as Recording Secretary of this Society.

Two years ago a resolution was passed by the Society providing that the transactions should be printed within sixty days after the Annual Meeting, and last year for reasons given by Dr. Bean in his report it was impossible to comply with the resolution. Upon adjournment of the Society last year I sought bids for printing the transactions and received two of $1.35 and $1.34 per page, both New York printers, in which place former transactions have been printed. Later, the first quoted bidder reduced his bid to $1.20 per page. It was not until the latter part of October that the Treasurer was able to furnish the list of members, etc., and a week later he sent in some corrections. I know, from my own duties allied to that of preparing a membership list, how difficult it is to impress upon members the necessity for haste in the matter, and the Treasurer informs me that he used all diligence in correcting the list of members. In the meantime I had sought bids outside of New York City for printing the transactions, and received from the Glens Falls Printing Company a bid of 84 cents per page, which I accepted. The stenographic notes were sent to me in such a form, with so many blanks to fill, that it was the work of a number of days to prepare them for the printer, and even then I regret to say errors occurred. It was my idea that the proof sheets of the papers read should be submitted to the writers for correction; but, through a misunderstanding of my letter on that subject to the President, it was not done. The printed transactions were received the evening of March 4, and the same evening I mailed copies to all active members, and on March 5, mailed the remainder to honorary and corresponding members.

I have had a great many applications from those who are not members for copies of the transactions, and these I have filled so far as I could. Dr. Bean turned over to me a consid-

erable number of copies of transactions for the year 1895, and I found in Albany a large number of copies of transactions for 1894, left there by a former Secretary. When these have been asked for I have mailed them to those who applied after consulting with ex-Secretary Bean and the President. A number of public libraries have applied for complete sets of the transactions, but I believe there are not half a dozen in existence. My own set, after years of earnest searching after missing copies, is still lacking a few years.

I would suggest that some formal action be taken by the Society upon the matter of furnishing copies of the transactions to those who are not members.

At the last meeting a resolution was passed restoring to the transactions a list of deceased members, and, after considerable correspondence I was able to secure a list of 24 names. In this matter I have received almost no assistance from the members in reply to my letters, and the list is made up chiefly from my own knowledge, after reading the lists of members in such copies of the proceedings as I have. I have found that the following names should have been added: Charles B. Evarts, George E. Ward, John A. Greusebach, Roland Redmond, B. L. Swan, Jr., Benjamin West and J. J. O'Connor.

It is earnestly requested that the members of the Society co-operate in securing a complete list of deceased members.

There may be some of the new members who are unaware that the American Fisheries Society was originally termed the American Fish Cultural Association. At that time the Association had a seal consisting of three crossed fishes, with the title of the Association inside of a circle. I would recommend that action be taken to restore this seal with the amended title of the Society as now recognized.

The address of T. H. Palmer, a member, is unknown to the Treasurer or Secretary.

The copies of the transactions mailed to Prof. B. Ben, Germany, and Don Francisco Garcia Sola, Spain, have been returned uncalled for, and I have received corrections in addresses of other corresponding members, and of a few active members whose addresses have been changed since the transactions were printed.

I must repeat what my predecessor had said, that the work of the Recording Secretary cannot be efficiently done without the assistance and co-operation of other members. There is con-

siderable correspondence connected with the office, and the work of preparing the transactions is not slight, but it is cheerfully rendered; and if members will assist in furnishing proper addresses and missing records, the proceedings can be made perfect and complete. I would suggest that, for convenience of the printer and Secretary, the stenographic reports of discussions following the reading of papers be made a part of the paper, and each paper with the discussion be complete in itself and not a part of the routine business.

On March 27 I sent out the first notice of the annual meeting for this year, requesting members to send to the Secretary titles of papers to be read.

On May 27 I sent out a second notice to all members, giving time and place of meeting in Detroit, with a summary of the program prepared by the local committee for the entertainment of the Society, and again asking that titles of papers should be sent in promptly.

There are on hand several hundred copies of the transactions of the Society for the years 1894, 1895 and 1896.

Respectfully,

A. NELSON CHENEY,

Recording Secretary.

Chairman Whitaker: There are certain suggestions made in the report, and it seems to me it should be referred to a committee, the suggestions be considered by them and reported upon. The Chair will entertain a motion for the appointment of such committee if desired.

Mr. Clark: I move that such a committee be appointed, although I do not wish to be appointed on that committee.

The motion was seconded and adopted unanimously.

Chairman Whitaker: I will appoint as such committee Mr. Bryant, Mr. Dale and Mr. Bell, and the report of the Secretary will be turned over to that committee and they can consider and report on the recommendations therein contained.

The following names were then presented in a letter from Mr. Cheney, the Secretary, for election as corresponding members of the Society:

J. J. Armistead, Dumfries, Scotland; S. Jaffe, Osnabruck, Germany; Wm. Seinor, Fishing Editor, "London Field."

On motion of Mr. Titcomb, duly seconded, the gentlemen named were unanimously elected.

Mr. Titcomb: For the interest of those who like good literature on these subjects I would like to suggest that Mr. J. J. Armistead is the editor of "An Angler's Paradise," which is a most interesting book on that and kindred subjects.

Chairman Whitaker: I quite agree with you, I think it is the most interesting book that has appeared on fish culture in a great many years.

There is also a letter to the Secretary from Dr. James, whom we all know to be an active member of this Society and a gentleman who always contributes some paper, notifying the Secretary, that on account of the meeting of another body to which he belongs holding its meeting at this time, and being in charge of two of its sections, he is unable tobe here and forwards a paper.

Mr. Clark: I would like to ask if the names presented in that letter, for membership, are supposed to be in the hands of the committee on membership?

Chairman Whitaker: They are in the committee's hands, and there are two or three other names that will be referred to the committee. I will read these communications because the Secretary is busy.

A letter from Mr. Cheney was read proposing for membership the following: Col. J. J. Brice, U. S. Fish Commissioner; C. C. Wood, Plymouth, Mass.; H. Seymour Bulkley, Odessa, Mass.

Mr. Stranahan proposed the name of J. C. Fox, of Put-in-Bay, Ohio, for membership.

The applications were referred to the committee on membership.

Mr. C. B. Reynolds, of New York, tendered his resignation, which, on motion duly made, was accepted.

Letters from the Chamber of Commerce, from the Mayor and Common Council of Nashville, Tenn., from the Governor of Tennessee, the Director-General of the Tennessee Centennial Exposition and the "American," "The Banner" and the "Sun" newspapers of Nashville, were read inviting the Society to attend the Exposition in that city.

On motion duly seconded the invitations were accepted and placed on file.

Mr. Clark: The committee on membership reported favorably on the names presented for membership, Hon. J. J. Brice, of Washington; C. C. Wood, of Plymouth, Mass.; H. C. M. Bulkley, of Odessa, N. Y., and J. C. Fox, of Ohio.

Mr. Peabody: Is it not customary to have the United States Fish Commissioner elected as an honorary member.

Chairman Whitaker: No, he is elected as an active member. You have heard the report of the committee that these gentlemen be elected to active membership; what will you do with the report?

On motion, duly seconded, the above named candidates were elected members.

Chairman Whitaker: I think, gentlemen, there are no other committees to report and there is no other routine business. We will now proceed to the reading of papers and the discussions. It is customary after each paper is read to take them up and discuss them. The first paper will be a paper on the "Vertical Distribution of the Lower Plants and Animals in the Inland Lakes," by Prof. E. A. Birge, of Wisconsin.

VERTICAL DISTRIBUTION OF THE LOWER PLANTS AND ANIMALS IN THE INLAND LAKES.

By PROF. E. A. BIRGE, of Wisconsin.

Prof. Birge: I did not expect to be called upon first and have not much to say. During the past three years I have been engaged in studying the history both of the distribution throughout the year and the vertical distribution of the small crustacea of the lake which immediately adjoins the University of Wisconsin, Lake Mendota. This lake is about six miles in length and from three to four miles in width, and, as you see, a rather large sheet of water as inland lakes go. It is a lake of some 85 feet in greatest depth, the greater portion of the lake being over 50 feet in depth. At a distance of about a quarter of a mile from the shore we reach a depth of about 60 feet and from that point on to the middle of the lake the increase in depth is quite slow, so that the greater portion of the lake is a plain varying only ten or fifteen feet from level.

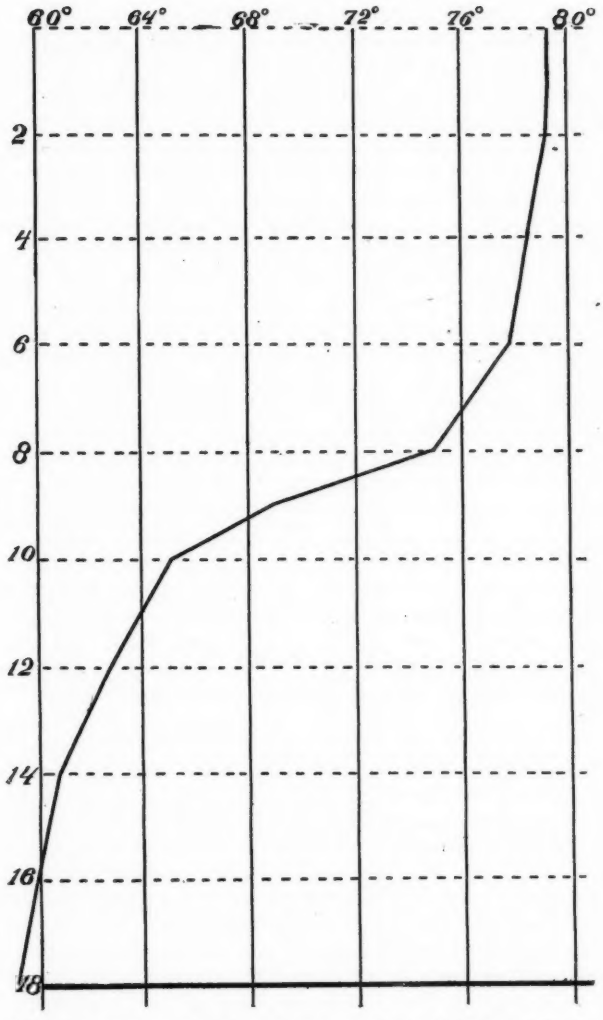
In studying the vertical distribution of these animals I employed a kind of a dredge so constructed that it could be lowered to a given depth, opened under the water, and then raised through any desired distance and closed again when it had reached the proper height. In that way it was possible to obtain the living plants and animals between certain depths. It is opened at the bottom, is then raised, say ten feet, is then closed and brought to the top and the contents taken out. In that way it is possible to get the plants and animals of the lakes from each stratum.

It is not my intention to go into the details of the distribution, but to call attention to one point only which seems to me to have some practical bearing. In order to explain that, it is necessary to speak of the temperature of these lakes. As we all know, the temperature of the bottom of our great lakes or inland lakes is decidedly lower than the temperature at the surface. While in Lake Mendota, for example, the temperature at the surface during the summer is 75° or even 80° on the hottest days, the temperature at the bottom is quite constant, somewhere from 50 to 60 degrees, varying with the different seasons, at a depth anywhere from 50 to 80 feet. The decline in temperature from the surface to the bottom is by no means a regular

one. During the spring, the period when the lake is warming up, the decline of temperature from the surface to the bottom is more or less uniform. But when the season has advanced, from about the 1st of July, in Lake Mendota, to the latter part of September, we find a peculiar distribution of temperature. The upper water of the lake, varying from about 20 feet in thickness to some 45 feet, is very nearly uniform in temperature. One may say, speaking roughly, that in the early morning, before the sun has had any effect, the upper stratum of the lake is practically uniform in temperature, falling, perhaps, in this distance of 20 to 40 feet, 1 or 2 or perhaps 3 degrees Fahrenheit.

Immediately under this stratum there comes a thin layer in which the temperature falls with great rapidity, sometimes falling as much as 10 degrees Fahrenheit in a meter, at other times falling less rapidly than that. But there is always a zone immediately below the warm water in which the temperature falls very rapidly and below which the falling of the temperature is quite uniform and slow until the bottom is reached. This little chart which I have had drawn to go with the paper will illustrate this.

This diagram shows the condition of temperature on August 12, 1896. In the diagram the horizontal lines represent depth in meters and the vertical lines temperature in degrees Fahrenheit. You will see that at the surface the temperature is about 79 and at the bottom a little above 59—a difference of 20 degrees between the top and bottom. But the line of temperature shows that the rapidity of the fall in temperature is very different at different depths. From the surface to 6 meters there is very little fall, somewhat more in the next two meters, while there is a drop of nearly 10 degrees from 8 to 10 meters, and a fall of only about 6 degrees in the lower 8 meters. It is plain that nearly one-half of the difference in temperature between the top and the bottom of the lake comes in the two meters from 8 to 10. The effect of this is that the lake becomes divided into two parts, horizontally. There is what you may call a warm lake on the surface from 20 to 30 feet thick, or of even greater thickness than that. This lake is subjected to the action of the winds and the currents keep the water stirred up, so that the water may be brought to the surface by the action of the wind. Below lies another lake, say from 20 to 30 feet below the surface and extending to the bottom, which is entirely undisturbed by the wind, in which the temperature



This Figure shows the temperature of the water of Lake Mendota on August 12, 1896. The vertical lines indicate temperature and the horizontal lines indicate depth in meters. For general purposes 3 meters may be reckoned as 10 feet. The heavy line going obliquely across the diagram indicates the temperature at the different depths, being 79° and a fraction at the surface, about 78° at 6 meters (20 feet), 65° at 10 meters, etc. On this date there were only 5,500 crustacea per square meter of surface between 10 and 18 meters, 24,000 between 9 and 10 meters, and 66,000 between 8 and 9 meters.

does not change except in connection with the zone where the warmth is working its way down very slowly as the season advances through the late summer and early fall. During July the zone of rapid descent of temperature—the bottom of the upper and warm lake—lies from 25 to 30 feet below the surface. In August the warm water may become as much as 40 or more feet thick and in late September the entire mass of water becomes mingled and uniform in temperature.

During the summer season, then, we have a warm lake on top subjected to the action of the winds, and a cold lake on which the wind has no influence. As a result we find that the bottom of the lake during the hot months of the year and during the months when most vegetation is found in all our lakes, is entirely cut off from immediate access to the air, and, furthermore, everything that goes down there stays there. In Lake Mendota the water down in the lake becomes decidedly foul, not as foul as in some lakes on record, but as the minute plants and animals of the upper waters die and sink, there results an accumulation of decomposing matter in the lower water, and the deeper or cold water becomes distinctly foul. It smells like rotten eggs, to put it plainly, and it tastes like sulphur water, evidently from compounds arising from the decomposition of these small plants and animals. As a result of this accumulation of decomposing matter the plants and animals of the lake which are the ultimate food supply of the open water, are unable to live in the lower water of the lake, and during the months of July and August and the greater part of September all of the plankton life of the lake is confined to the upper water. You may say that 95 per cent. and more of the crustacea, and the proportion of plants would not be essentially different from that, are found in the warm water above, and less than 5 per cent are found in the cold waterin the lower part of the lake. It makes no difference whether you go to the shallower part of the lake or the deeper part. Where the lake is say 85 feet in depth there may be 50 feet of this water with practically nothing in it with the exception of a very few small animals and many of these are in a weak and dying condition. Apparently you get none of the smaller forms, except those that have become weak or are dying or have got stuck in moulting their shells, and in one manner or another become incapacitated and sink down there toward the bottom.

The bottom of the warm water forms the lower limit of the plankton life and this life closely follows that limit as the warm

water gradually increases in thickness during the summer and early autumn—in late August and September.

Chairman Whitaker: To the bottom?

Professor Birge: Towards the bottom. In October you may say in a general way the crustacea and the plants are distributed about uniformly through the whole depth of the water. I can illustrate the distribution of the animalcules on certain dates when they were accurately determined. For instance, figuring the crustacea on this particular day, August 12, 1896, below 10 meters there were in a column of water a meter in area, and 8 meters in depth, 5,500 crustacea. In the lower part of the warm water, in a cubic meter of warm water, there were 24,000. There were four times as many crustacea in the bottom meter of the warm water as there were in the whole 8 meters that lay below. In the next meter above there were 66,000 crustacea, so that the difference is simply enormous. On another date there were found 3,600 crustacea, from 11 to 18 meters, while in the next meter above (10 to 11) there were 20,000, and in the meter above, 43,000 crustacea in a single cubic meter. So that while in the 7 meters below the warm water there were only about 500 crustacea per cubic meter, in a single cubic meter above there were 20,000, and in the next above that twice as many more, over 40,000.

Now you can see the bearing of this. There are some insect larvae, not very numerous, that go right up and down through this stratum, and there are mollusks, Cyclas, that we find in the mud at the bottom. But you can see at once that the supply of food for fish in this bottom water under this condition of things must be extraordinarily small. Now, I imagine that one thing which all fishermen tell us, that the white fish in Lake Mendota congregate during the summer in the region of the springs, is possibly true (although I have never been able to locate those springs). It seems reasonably clear that if they spread themselves around the lake they must get short picking in the matter of food, because very little food is there. And so, again, it is possible that this scarcity of food is one of the causes which brings about the death in our region of a considerable number of white fish towards the latter part of the summer.

The other point of practical importance is this: This accumulation of decomposing matter in the lower part of the lake may not be without a direct effect on the fish life that is present. Just about thirteen years ago, in 1884, we had in Lake Mendota a

very great mortality among the perch. There must have, on a moderate estimate, from five to eight million of perch died in the lake during the summer. You remember it very well, Gen. Bryant? They washed up there on the shore. The street superintendent buried from the city bank of Lake Mendota over 200 tons of these dead perch that washed up there, and that includes, perhaps, only three miles of the front of the lake, which must be some twenty miles in circumference, and they were washed up like that all around the edge of the lake.

You will find a report of this by Professor Forbes, who came up there to investigate the cause of the fish dying. He was sent there by the Fish Commissioner, and came there in the latter part of the mortality, and he found nothing as to the cause. I studied it all through the season, but was unable to discover any cause.

Professor Forbes' report is found in the eighth volume of the Bulletins of the U. S. Fish Commission, 1887.

Chairman Whitaker: Were there any physical appearances in the fish to indicate anything in the way of parasites?

Professor Birge: You could see nothing; no, there was nothing in the way of parasites. You would find fish swimming around the surface. On a calm morning you could look out over the lake and you could see the lake spotted with these fish as far as the eye could reach; many of them dead, some of them feeble and wriggling around the surface. If you picked up one of those fish the blood from that slight pressure would simply strain out over your hands, and on opening one, the intestines seemed to be drained of blood, it was all choked in their gills. If you examined them, you would find practically that all the blood of the body was in the gills and kidney. Now, I saw nothing to account for this. I studied the blood vessels and cut sections as well as I knew how, and I was still unable to find anything. Professor Forbes also worked at it and was unable to discover anything.

Within the last two or three years, since finding this accumulation of decomposing matter in the bottom water, it has occurred as a possibility, but I would not give it as anything more than a possibility, that there may be poisonous compounds in the water which might be the cause of such epidemics. The stomachs of the fish were nearly empty, though sometimes they had insect larva in their stomachs, the regular food on which they lived, and there was nothing to apparently cause this epidemic.

Chairman Whitaker: Then their condition did not show that it was from the effect of starvation? They had not gotten into this barren zone of water in the bottom and starved to death?

Professor Birge: No, I saw no reason to believe that. The fish were reasonably fat, and food was in their stomachs.

Mr. Clark: Were any other fish affected besides the perch?

Professor Birge: The whitefish also. They die every year in certain numbers. I have never been able to get hold of a dying whitefish to see whether its gills show the same symptoms. Many more died this year than ever before.

Chairman Whitaker: Have there been any recent physical changes in the character of the lake?

Professor Birge: No.

Chairman Whitaker: Have there been any artificial changes that would tend to contaminate the water at all?

Professor Birge: No. At that time, I think, there was no sewerage discharged into the lake, and the lake, except for having a border of inhabitants, was in the same condition it had been since the dam was put in there 30 or 40 years ago.

Chairman Whitaker: Has this great mortality been of frequent occurrence?

Professor Birge: Never before, never since.

Mr. Nevin: Last year in Barron County, Wis., the whitefish died in great numbers.

Professor Birge: Those epidemics are only occasional. We do not often get a chance to study them, and it seems to me it would be well worth while, if one could get an opportunity to study it with reference to the condition of the bottom water of the lake, to see whether, under some exceptional conditions the bottom of the lake does not get exceptionally foul and thus accumulate poisonous material which may cause directly the death of these fish. I ought to add, however, that the Mendota epidemic ceased about the middle of August, while the lower water must have been still foul.

Mr. Clark: You did not examine to see if it affected the animalcules of the lake?

Professor Birge: At that time I was not studying them, but it is quite evident that the crustacea do not live in that water. The

insect larvae will, as you know, stand almost anything in the way of foul water. The rotifers do not go down into the stagnant water.

Chairman Whitaker: Over how long a period of time did your observations extend?

Professor Birge: A space of two years.

Chairman Whitaker: I meant as to season?

Professor Birge: I have gone right through the summer and winter. I began in July, 1894, and went along from that time, making more numerous experiments during the summer. Taking the year through, nearly every other day, during the two years.

Mr. Tomlin: Was it not very warm weather during all this time of the epidemic?

Professor Birge: Not extremely hot. We were not doing any work on temperatures at that time, but whether the season is very hot or very cold makes very little difference in the temperature of the deep water. The temperature of the deep water depends a good deal more on the concurrence of the warm weather and alternate calms and high winds in the early spring than it does on anything that happens in the summer. After this middle zone is established the bottom water does not get affected at all by warm weather.

Chairman Whitaker: Does it not later in the season?

Professor Birge: Not until September, and then the surface water has cooled gradually before the bottom water gets affected. The temperature of the bottom water rises rapidly before the first of June, and then keeps very nearly uniform until late in September, when it goes up pretty rapidly in connection with the mixing of the temperatures by the wind, as the temperature on the surface of the water falls.

Mr. Stranahan: Was this mortality confined to the portion of the lake over the deep water?

Professor Birge: That is hard to answer specifically. These points all came to me years after the affair was over, and I did not take all the observations then that I would now, but it was generally true that the dying fish were out in the open lake. As I recollect it, I do not recall seeing any dying fish close to the shore, unless there was a strong wind

bringing them in, and when you saw those fish they came from the surface out in the open lake, not from near the shore.

Mr. Titcomb: I would like to inquire how the lake is supplied with water. Is it by springs?

Professor Birge: There is a small creek, but a good deal more water comes in from large springs at the part of the lake furthest removed from the city.

Mr. Titcomb: In getting at the temperatures, of course the waters nearest those springs would remain coolest the year round, have an even temperature, would it not?

Professor Birge: I have done very little work at that end of the lake. The temperature of the creek during winter and the bottom temperature of the lake, falls below the temperature of springs. It falls to 35 or 36 degrees at the bottom and it does not rise anywhere until after the ice goes out in the spring, so that this inflow of water is not sufficient to raise the bottom temperature, through, say, three and a half months of the winter.

Mr. Titcomb: I was making inquiries, because I have been taking observations of temperatures in the trout lakes of Vermont, and we have lakes fed there largely by springs, and the temperature remains very even, within 20 feet below the surface. You go 20 feet below the surface and you will get a temperature of 40 to 46 the year around. The lake is about 1,500 feet across and two miles long.

Professor Birge: The bottom temperature differs in different inland lakes more with reference to the area than in respect to the direct depth. In Oconomowoc Lake, which is perhaps a mile or a mile and a half long, the bottom temperature is about as you get it in Vermont, about 43 to 44 degrees, at 60 feet in depth, while in Lake Mendota, which has a greater area, the bottom temperature is 60 degrees.

This peculiarity of the foulness of the bottom water is true only of lakes where there is a rich plankton. The other lakes of which I speak, Oconomowoc Lake and Pine Lake, are typically plankton poor lakes, where there is not one-twentieth as much of vegetable life as in Lake Mendota. In both those lakes crustacea go nearly or quite to the bottom. The foulness of the water is from the quantity of material dropped down there from the surface.

Mr. Titcomb: With reference to epidemics, I will say a word about our experience in Vermont. We have not had an opportunity to study it there, but the Professor's remarks upon that thought are very interesting to me. We have one lake inhabited by trout and bullheads—the bullheads were evidently artificially introduced. It is not a natural pond for them, but the bullheads throve there for years, until last year there was an epidemic. No trout died. The bullheads in that lake came to the surface and lined the shore in the same way you describe, only in less quantities. In another lake in Vermont we had an epidemic among the perch in the same way you describe, although not in any such quantities, and the third time, three years ago, we had still another epidemic among bullheads in a sort of dead creek which is tributary to Lake Champlain. The bullheads in Lake Champlain, in clear waters, are delicious food fish. We call them the "poor man's fish" there, because they catch them all the time through the summer, night and day, but in this dead creek, one of those sluggish waters, they taste of the dirt and are foul. We never have investigated the causes of these epidemics. In fact, in the case of a trout pond, where an epidemic occurred, it is the source of water supply for quite a large town, and the corporation officials are very careful to remove those fish as rapidly as possible, to keep the people of the town ignorant of the condition. So, I did not get hold of it until afterwards, but if it is a question of foul water, it seems to me it endangers the sanitary condition of the water supply of that town.

Professor Birge: That is not necessarily true. If you will look into the reports of the Massachusetts Water Commissioners, you will find that they say the water supply must be taken from the upper surface, that the lower water will be unfit to drink in later summer.

Mr. Titcomb: There is a question that comes up in connection with my investigations. I always thought, for the purpose of getting a constant water supply of large volume and even temperature, you must take the water from a large lake to which trout, for instance, are indigenous, and taking it from the lower depth or stratum, where the water remains at a constant temperature of 48, you get a sufficient amount or sufficient volume to run a hatchery to an unlimited extent.

Professor Birge: That would depend entirely upon your lake. If you have a large supply of spring water coming in

there, and the amount of vegetation in the lake is small, it may do the work perfectly well. But if the conditions are as they are in Lake Mendota, and it is a great deal worse in some other lakes as reported by the Massachusetts Water Commissioners, you can readily see you could not run a hatchery with that water. If the bottom water is pure in late August and September, it would be all right at any time of the year, but it would have to be a matter of investigation with each individual lake.

Chairman Whitaker: There are some things that have occurred to me in this connection, and I do not know but your last remarks explain it. Do you know whether this condition of affairs happens occasionally in a lake, or does it obtain in all your lakes in a measure?

Professor Birge: These temperature conditions belong to all lakes of any depth.

Chairman Whitaker: I speak with reference to the foulness of the water.

Professor Birge: It depends upon the amount of the floating plants and animals. There are various conditions in lakes in that regard. In Green Lake, in Wisconsin, which, you may know, is a lake of about the same size as Lake Mendota, though of different shape, but about 200 feet deep, at a time when the plankton vegetation is most abundant, there is not a fourth as much as there is in winter in Lake Mendota. It is not a question of bad water at all, but of the natural capacity of the lake to grow vegetation. Upon what that depends, I don't know, but there is more difference in lakes in capacity to grow vegetation of different sorts, than there is between fields to grow grass, and in lakes abounding with this vegetation the water will be foul.

Dr. Parker: Did you learn anything about the presence of female fish among those dead fish?

Professor Birge: I made no observation on that, as far as I recollect.

Dr. Parker: How was it in regard to the bullheads, Mr. Titcomb?

Mr. Titcomb: The whole lake was cleared out of the dead fish and we could not investigate it, as we did not learn of it in time. I do not think there was anything abnormal in the weather; I am sure they had spawned, as this was along in July

and August, and the season was not a particularly abnormal one any way.

Chairman Whitaker: May I ask a question of you? There are some things in connection with the paper that seem to me might have a bearing on the general movement of fish from one depth to another, in relation to fish food. If I understand you right, as the season progresses, up to September and October, the conditions of temperature are reversed, the top growing cooler as it nears the fall months, and the temperature gradually rising at the bottom.

Professor Birge: That is not quite correct. The story is rather a long one. In one lake which has been investigated, that is 60 feet deep, the bottom remains of a constant temperature until November. The lake being so small the bottom temperature practically rises only a fraction of a degree until the water begins to be mixed by the influence of the winds. Of course, the area of the lake makes a very great difference in regard to the effect of winds.

Chairman Whitaker: When that change takes place in the water is it by reason of violent winds, or by changes of season, or by transmission of caloric from the top to the bottom, and when it has changed, are the bottom waters richer in plankton than the surface?

Professor Birge: Very much richer than they were, but never actually richer than the surface strata.

Chairman Whitaker: It seems to me this is a very interesting question. May that question not govern somewhat the movement of fishes? May they not find a richer field at the bottom in certain months in which to live? If they do not hibernate, but if they actually do go to the bottom and feed, may not that result from the changes nature sets up in this way?

Professor Birge: I cannot speak with knowledge of that, except with reference to the perch in Lake Mendota. They go to the bottom in winter; are caught in immense quantities in the lake in anywhere from 40 to 60 feet in depth. But the stomachs of the perch during winter are pretty nearly free from food.

Mr. Clark: Do they not go to that great depth to get a warmer temperature?

Professor Birge: They don't get a much warmer temperature at the bottom during the winter; the temperature near the

bottom is near freezing—ordinarily it is between 34 and 36 degrees at the bottom. It stays there all winter, and the lake reaches a temperature within a fraction of that a very short distance below the surface, so that you see it is not very much warmer at the bottom.

Mr. Davis: Is it not possible the death of these fishes is caused more by epidemic than it is by what they live upon? Last week I was north near Baldwin, in this State, and I learned there that the trout were dying. A certain kind of trout, the brown trout, were dying in considerable quantities in one of the streams. I did not have an opportunity to see any of the dead fish, but I made arrangements to have some of them sent here to Detroit. A sort of epidemic seems to have attacked the brown trout there, but none of the rainbow or brook trout died. Now, we consider the waters of the Pere Marquette River and its branches pretty pure water, and it strikes me there must be something of an epidemic.

Professor Birge: There was evidently an epidemic here, to cause the death of several millions of the population of this lake. That was entitled to be called an epidemic, but the trouble was to find out what the cause of the epidemic was. We looked for all sorts of parasites, internally and externally, and we could not find anything significant.

Mr. Davis: I understand the brown trout up north are covered with sore spots.

Professor Birge: That would indicate they are attacked by a fungus, then.

Mr. Davis: And by the lamprey eels.

Chairman Whitaker: It is rather a singular thing, that only the brown trout should be affected.

Mr. Clark: I do not suppose there is anything remarkable about its affecting one kind of trout in a stream and not another. We found that right in our ponds. We had an epidemic at Northville over a year ago which simply depleted our ponds of brook trout. Of course, we had to look around to see what caused it. The brown trout in the same water were not affected at all. That is probably the case with this stream, it affects the brown trout and not the others.

Dr. Parker: In mentioning whitefish, you spoke about their food possibly being affected by the condition of the water at the

bottom, the foulness of the water. Have you examined very closely as to the food of the whitefish?

Professor Birge: I have not at all.

Dr. Parker: I could give a little history of my connection with that a great many years ago. I found in some whitefish brought from Lake Michigan to Grand Haven, that the food in the stomach of the fish was a small bivalve not larger than a grain of sand. I was quite nonplussed at first in looking it over. I was looking for something larger in the stomach of the fish, and I examined several before it occurred to me to make use of the magnifying glass. I did so, and I found that what I supposed was sand was a very minute bivalve shell. Afterwards, in examining a fish on the Lake Superior shore, I found not only the same small shell, but I found other shell fish there, the paladina. I was quite surprised to find this and other large shells there.

Professor Birge: Didn't you find also with the bivalves the mysisina? We found them at Charlevoix, and I think that was their chief food, was it not, Mr. Post?

Mr. Post: I think so.

Dr. Parker: My examination was not very thorough, but as far as I could tell, I came to the conclusion the fish were feeding on that bivalve.

Mr. Tomlin: In connection with my duty in the neighborhood of what is called Dead Lake, Minn., from the 15th of July until about the 20th of August following, I was around on the different sides of the lake. It is about 25 miles long, running from two to nine miles wide. The bass, both the black and what we call the green bass, grow there to very large size. Three years ago this next month the black bass and the red horse, or what is commonly known up there as the sucker, were found dead in the pond, and the stench was intolerable. There was no use trying to bury them. The settlements were so few there was no possibility that anything in the shape of sewage should have caused the fish to die. I hold in my hand the report of the Western Society of Engineers, and there is a little item in that that may throw some light on the professor's subject. It says "there are tides in every pond, however small and insignificant, they are there and perceptible." The level of the lake has not undergone any variation and the depth and area of the basin remains the same. It seemed to me, while the Professor was reading this

remarkably interesting paper to us, that this matter was old. The tides in such a lake as this would stir up all the deleterious matter from the bottom of the lake and thus cause the death of these fish. Whether I am right or not, I would not say, but the thought occurred to me at the time.

Professor Birge: Lake Mendota has no tide. There is no question about that, and there is no stirring up of the lake. The water below is as calm as water which is bottled up tight. I do not want to be understood as offering any general explanation of fish epidemics. I refer to this as something, so far as I know, that has never been referred to. Fish epidemics are one of the most interesting and difficult problems that fish culturists have to deal with, and while I have no doubt they are due to as many different causes as human epidemics, I brought this forward, not as a certain, but as a possible cause of the epidemic and one worthy the attention of all of us when we have a chance to study an epidemic of this sort.

Chairman Whitaker: I am very sure we are all much interested in this matter and in the remarks that have been made extempore by the professor. It is plainly evident that the professor's apology, to start with, was unnecessary. He said his paper was not written, and it seems to me very fortunate for the society that it was not written, it was more entertaining in the form in which it was given.

Wisconsin and Illinois are both working along lines which, it seems to me, are bound to be a benefit to fish culture. We have long witnessed these so-called epidemics of fish without any attempt to solve the matter. It is just about as valuable when we merely see and speculate about these things, as it is to look at an aquarium without any information as to the life and habits of fish—simply to satisfy an idle curiosity. We have got to a point where it seems to me essential that fish culturists, who are attempting to restock the waters, should be aided by scientific investigators, and that the two should work together; the scientific men settling those questions that scientific men alone can settle, by investigation. In that way we shall get at the cause of these things, and there is nothing in fish cultural experience that cannot be solved along the lines of inquiry that are being pursued in those two states to-day. I am sorry to say that while Michigan for two or three years had a good bureau of scientific inquiry, in the hands of able men, it was compelled to discontinue that work because of lack of money. It was a great mistake,

but we must not quarrel with things that exist, but, if we can, correct them. It is a very gratifying thing to know there are two states that are working along these lines. Illinois has established what is called a natural history observation station. It is in the hands of a very capable man with able assistants, and there is no question but good results will follow. I congratulate Wisconsin upon having associated with its commission a man who has not only the ability, but the inclination to follow out these investigations that will certainly result in benefit to fish culture. These investigations may at present seem somewhat remote, but they are not so, and in order to get an intelligent conception of the matter, the whole range of inquiry as it is related to the different forms in water, temperatures and all those things that are naturally connected with it, these investigations must be made in order that just conclusions may be drawn.

We will now listen to a paper by Professor Reighard.

Professor Reighard: I had intended to present a review of what has been accomplished in the scientific study of the fresh waters, since the revival in that line of study; but when I came to look into the matter more carefully I found there was so little of it, and so much of that that was not of direct interest to practical fish culture, that I limited the paper to certain thoughts on the recent developments in the study of fresh waters from a scientific point of view.

SOME CHARACTERISTICS OF RECENT WORK ON THE BIOLOGY OF FRESH WATERS.

By PROF. REIGHARD.

I had intended to prepare a paper reviewing what had been accomplished in the scientific study of the biology of our fresh waters, but an attempt to carry out this purpose soon showed me that a paper so prepared would include much matter that does not especially appertain to fisheries. I shall, therefore, not attempt to carry out the original plan of giving a summary of results, but shall point out merely two lines along which advances have been made, and shall then indicate the bearing which some of this work has upon practical problems.

Perhaps the most striking feature of recent scientific work on our fresh waters has been its rapid extension within the past few years. Before 1890 scientific men, zoologists particularly, had given attention to the sea, almost to the exclusion of the fresh waters. The sea contains representatives of more animal groups than the fresh water, and it contains also a large number of forms generally considered to be primitive. To the sea, then, zoölogists have generally turned for the solution of their scientific problems. Within ten years, however, a reaction has made itself felt in the direction of the study of fresh water animals. Interest in this study finally led to the establishment by Zacharias at Plön, in North Germany, of a laboratory devoted exclusively to the study of the fresh waters. This laboratory, which has been subsidized by the German Government, was the first of its kind. Like most of the similar laboratories which have been since established, it is a purely scientific institution, whose object is to afford facilities for the solution of the problems of fresh water biology. Its founder, Dr. Zacharias, hoped that its investigations would furnish data for the solution of many of the practical problems of the fisheries, and he did not hesitate to hold forth this hope when asking for financial support. Its realization can only be a matter of time. In this connection it cannot be too forcibly pointed out that science cannot afford to serve. Her best results are obtained when she is left quite free to grow at her own gait and in her own way, and these results cannot be other than of value to the useful arts. It is a mistake to require that a scientific institution should

devote itself exclusively to the solution of practical problems. Its workers should be left free to develop each in accordance with his own bent. Thus will the institution be most efficient; thus will knowledge be most rapidly widened, and thus, too, will practical problems, soonest reach their final solution. Final solution of such problems depends on fulness of knowledge, and fulness of knowledge is not to be attained by an investigation directed narrowly toward the solution of a practical problem.

The station at Plön has been followed by others in different parts of Europe. One of these, that on the Mugelersee, near Berlin, has been founded and is conducted entirely in the interest of the fisheries. Investigations have further been undertaken of Lake Constance and of Lake Geneva.

Stations have also been established in this country. That on Gull Lake, started by the University of Minnesota, was in existence for but one year. It seems to have been the first of its sort in this country, but I do not know that any results of importance have come from its establishment. The station maintained by the Michigan Fish Commission on Lake St. Clair in 1893, and on Lake Michigan in 1894, was the next in order of time. The results of its work have been embodied in five bulletins issued by the Michigan Fish Commission. In 1895 there was established by the University of Illinois a fresh water biological station, of a purely scientific character. It has now completed its second year of work, under the directorship of Professor Forbes, and several valuable papers have come from it. The unique location of this station and its excellent facilities lead us to expect much from it. In the meantime there has been established a summer station on Turkey Lake, Indiana, in connection with the University of Indiana, and several papers have already appeared from it.

A second characteristic of the work on our fresh waters has been the introduction since 1890 of exact methods. The (fresh water) biologist aims at a physiology of organisms. He desires to measure, count, and weigh the animals and plants of a given area, and to determine their food relations to one another. By such means he hopes to be able to trace continuously and quantitatively the transformations of matter from the inorganic constituents of the soil through the bodies of plant and animal and back again to the soil. The difficulties in the way of such an accomplishment are insuperable in the case of terrestrial plants and animals in a state of nature. The enumeration alone of the plants and animals of a single acre of wild land is an impossibility,

and even if the task were possible, the continual changes would render it fruitless. In the ocean attempts to do quantitative work are rendered difficult by the great number of species of animals present. In the fresh water the number of species of minute animals and plants present (excluding those that live in shore or bottom) is only about eighty. When, now, it has announced that a method has been found of counting, weighing and measuring all the animals and plants occuring in a given volume of water in a lake, or occurring in the whole lake, an immense stimulus was at once afforded to the investigation of aquatic biology. The animals and plants which live upon the shores or bottom of a body of water form only a small part of all the organisms that it contains. Far heavier and bulkier than the sum of these is the sum of those minute forms that are found floating in the free water removed from the influence of shore or bottom. These forms are small and weak and are buffeted about at the will of waves and currents. Taken together they make up what we call the plankton. The method which had now been devised was one of measuring the organisms of the plankton, not those of shore or bottom. It might seem at first sight that nothing could be easier than to dip up a bucket of the water to be investigated, filter it and weigh and measure the animals. But it must be remembered that water at different depths might contain different amounts of plankton, and hence it was necessary that the sample of water taken should extend from the bottom to the surface, so as to include water from all depths. The sample must bear the same relation to the whole volume of water, that a disc punched from the center of a sheet of metal bears to the whole sheet. No simple method of actually removing such a sample of water from a lake seems to be possible, but an exceedingly simple method has been devised of removing the plankton from a sample column of the water. This consists merely in drawing a fine net vertically from the bottom to the surface. The contents of the net are then removed and measured and weighed, and the individual animals and plants which it contains are counted. It is necessary that the material used for the net should be so fine that it will retain the minutest organisms, and such a material is found in the finest bolting cloth used by millers. The net must further be provided with a cup at the bottom to receive the minute organisms which are washed into it. Other precautions are necessary both in taking the plankton and in its subsequent study, but these need not be entered upon here. It is enough to know that a properly constructed net drawn from the bottom to top

yields a sample of the plankton in a lake, and that such sample may be weighed and measured and its constituents counted.

This method was first introduced by Professor Hansen, who used it in the study of the marine plankton and described it as early as 1887. It was subsequently modified and used in some of the fresh water lakes of North Germany by Hansen's pupil Apstein in 1890 and later. Since then the method or some modification of it, has been widely used. When we remember that aquatic plants are dependent for their nourishment on the materials dissolved in the water, and that aquatic animals are directly or indirectly dependent on plants for nourishment, we realize that a measurement of the plankton is a measurement of the relative productive capacity of a body of water. We thus have for the first time a method of determining how much organic matter a given body of water is capable of yielding, and the importance of this method for fish culture has hardly yet been realized.

Investigation by this method soon showed that the plankton of a lake was uniformly distributed. The lake might be compared to a field of wheat in which the plants were growing uniformly over the whole field. A square yard anywhere in such a field would yield approximately the same measure of wheat grains. Similarly it was found that the plankton net gave approximately the same results, no matter in what part of the lake it was used. Thus it became evident that in order to test the plankton production of a lake it was necessary to make but a single haul of the plankton net.

Now let us see what the results have been of the comparison of different lakes by this method. We are apt to think of a lake area as we do of a land area and to imagine that if a lake an acre in extent produces a certain weight of fish a lake one thousand acres in extent should produce one thousand times that weight of fish. When we turn to a very large lake, such as Lake Michigan, we are apt to think of it as we think of the ocean, as being inexhaustible. In thus imagining that the productive capacity of a lake is proportioned to its size, we fail to take into account certain important facts. The whole source of food supply for the inhabitants of a lake is contained in solution in its waters. The plants live directly on the materials thus in solution in the waters of the lake, and the animals in their turn feed upon the plants, or upon one another. When we inquire as to the source of the materials in solution in the water of a lake, we find that they have all been introduced from without. They are brought in by streams, they are

washed from the shore by waves, they are, to a small extent, carried in by winds and rains. Now in a very large lake the proportion of the shallow water to the whole area of the lake is much less than in a small lake. It is in this shallow water that the wave action takes place which washes out from the soil the plant food materials which came to be dissolved in the water of the lake. This same shallow water further gives anchorage to plants which furnish shelter for many fishes and for their food. Consequently the shorter the shore line of a lake and the less shallow water it contains, the smaller is likely to be its production of fish per unit of surface area. Our Great Lakes have all a comparatively straight shore line with very little shallow water off shore, and hence should on this account alone be expected to yield a smaller proportion of fish per unit of area than smaller lakes. Their drainage basin is relatively small, and consequently relatively little plant food is probably brought into the lakes by the tributary rivers. In general, it is true that the larger the lake, the less may be expected to be its productive capacity per unit of area.

When, however, we turn to an actual measurement of the productive capacity of one of our Great Lakes by the use of the plankton method, we are astonished at the result. Those smaller European lakes whose plankton has been measured are found to fall into two classes which are called plankton rich and plankton poor. As compared with the plankton rich lakes of North Germany our own Great Lakes are found to contain only about one-twentieth as much plankton per volume of water as these. As compared with the plankton poor lakes the Great Lakes contain somewhat more than one-half as much plankton per volume of water. The Great Lakes are on the average, then, the poorest in plankton of any lakes that have been hitherto studied. I see no escape from the conclusion that they contain also a smaller proportion of fish per unit of area or volume than would smaller lakes. The great size of the lakes does not then justify us in expecting larger returns from them, it rather warns us that we should expect less. The commercial fishes of the Great Lakes are taken in large numbers within restricted areas. It is natural to assume that we are thus sampling what occurs on a large part of the lake. We fancy that we may go on fishing indefinitely, and somehow out of the huge expanse of water fish will come to our nets as fish always have come.

The capacity of a field for the production of any crop is limited. If we supply the field with a certain amount of fertilizer

annually, we may take from it a certain product. If we attempt to take more the field becomes exhausted and refuses to yield. We cannot increase the yield by doubling the number of seeds planted; we cannot increase it by adding to the annual supply of fertilizer. Our Great Lakes are limited in precisely this way. Fertilizers they get from the tributary streams and from the erosion of their shores. They are capable of yielding a certain annual return in fishes. What that return should be we do not know. We cannot add to the supply of fertilizing material, as we might in small ponds. It is useless to plant more fish than can live. Enough should be planted, and until the fisheries are restored and the catching of immature fish stopped, it is not likely that planting can be overdone. But with it all let us remember the limited productive capacity of these lakes and let us learn from this that the only thorough going remedy is to restrict the fishing within that capacity. This seems to me to be the most important lesson to be drawn from recent studies in fresh water biology.

DISCUSSION.

Mr. Clark: Mr. President: In reference to this paper of Professor Reighard's, I was unfortunately called out, so that I only heard the first part of his paper, but a thought occurred to me in connection with what I did hear and I think I had better mention it. It was in regard to the different States commencing these scientific observations of the fresh water lakes. Of course, the members and others know what the United States Commission has done in a scientific way for salt water, and this thought occurred to me, it was to be regretted that something has not been done in this direction on the great lakes by the United States Fish Commission. I am glad the United States Fish Commissioner expects to take up that work, and intends to establish scientific stations on the great lakes. In a conference I had with Dr. Smith and others of the Fish Commission in Washington recently, I was told it was expected to take it up this season. They realize its importance and that it should be done, but I very much doubt their taking hold of it this session, as the money, within the last few weeks, as the superintendents here know, is short. But it is the full intention of the United States Fish Commission to take hold of that work.

Mr. Stranahan: I would like to ask the professor what the amount of plankton in Lake Erie was, as compared with the other lakes, just in an off-hand way?

Professor Reighard: We made only three hauls in Lake Erie, those were made just after a storm. We were storm-bound there a great deal, and we only had two days to work in. We found a good deal more than we did in Lake St. Clair or in Lake Michigan. Just what the relative amounts were is given, I think, in the report. I think in those three hauls we got about three times as much in Lake Erie as in the other lakes. Of course, this was in the west end of Lake Erie, where the water was shallow, and where you would expect more.

Mr. Stranahan: Would that come under the head of plankton poor?

Professor Reighard: Yes, it would still come under the head of plankton poor.

Mr. Bryant: I cannot add anything of scientific value to this paper, from the fact that I am unable to do so, as my state of knowledge is hardly up to the point, to enable me to enter into a discussion of this question from a scientific point of view, but I am deeply impressed, perhaps with the zeal of a new member, with the importance and value of enlisting in the work of this society these scientific investigators, and, for that reason I think our time of meeting, when we come to consider it, should be so adjusted that we can find at liberty and have with us those gentlemen of the various educational institutions of the country who are engaged in this work. The little experience I have had as a member of the commission—making it more of a by-study than anything else, owing to exacting labors in another field of work—have convinced me and I have felt impressed, the more so the more my experience has extended, of the necessity of having more exact scientific knowledge to guide us in the distribution of the fish we propagate. The discussion here to-day has greatly interested me. It has opened up to me the possibility that may be reached when these gentlemen, engaged from the standpoint of pure science, not from the point of immediate practical results, have pushed along the line of knowledge until they are able to tell us their views based on an investigation, and their deductions shall coincide with our experience in determining the best methods of adding to the fish product of the country. I have felt impressed, in our experience, which has been somewhat varied; we have tried various kinds of fish propagation and distribution, transplanting of small fish and of grown fish, I have thought that there must of necessity be a great deal of waste,

from the fact that we were not always sure we were putting the right thing in the right place, or perhaps at the right time; and I am strongly impressed with the idea that this society can, by being a stimulant, as it were, enlist in aid of the great brotherhood of fish culturists everywhere, the scientific and the practical, and the political, if we must, in one grand army of men who are resolved to make their day and generation an epoch of results in this class of work. (Applause.)

Prof. Birge: I would like to say one word in indorsement of Professor Reighard's paper, and as to the necessity of scientific study and the length of time to reach results. Let us consider what is being done in the investigation of agriculture. I do not know what you are doing in Michigan, I presume it is the same thing as in Wisconsin, where there are between $75,000 and $80,000 spent annually by the State and National governments in the scientific investigation of agricultural problems. That is on top of the millions of dollars which have been spent in general chemical investigation which bears on the problems and the other millions of dollars which are spent by foreign governments and our own government in the investigation of special agricultural problems. Now, in spite of this great expenditure of money and of the efforts of quite an army of scientific men, they are just making a beginning in their knowledge. Now, while, as Professor Reighard has just said, the biology of the fresh water lake is a more simple problem than the biology of the field, it is by no means a simple problem. It is one which must be worked at from a scientific standpoint for a great many years before practical results will follow with the same kind of certainty that the agricultural chemist reaches his practical results to-day. We have not that degree of knowledge of the conditions of fish life that the agricultural chemists of the field when the agricultural stations were established. We have not one per cent. of the amount of information which was at their command at that time, and the work which scientific men do, and which they must do for a great many years to come, will very largely be in the direction of pioneer work, obtaining such information as the chemists obtained before the agricultural chemists went to work. It seems to me the attitude which this society takes it a reasonable one; that the scientific work must be done without anticipation of immediate practical results, in order to lay the foundation for securing practical results in the future such as agriculturalists are getting now from their experimental stations.

Illinois has begun this work in the only reasonable way under the direction of Professor Forbes. They are spending five thousand dollars a year or more in work that the average legislature would say was purely dead work. It is this measuring and counting of plankton, the chemical work, on water which must be done at the present time. These investigations do not directly aid the work of the practical fish-culturist, but they will form for the future the basis on which the practical fish-culturist will ground his work; just as the scientific farmer to-day bases his work on the results of the experimental station, which again, in its turn, rests back on the knowledge which science has been accumulating through the past generation.

The problems for us in the life of these inland waters must be taken up in that same way and worked out in that same temper, without anticipation of immediate practical results this year or next year, or even in five years.

Chairman Whitaker: It is with a great deal of pleasure I learn from Mr. Clark that the United States Commission has finally determined to take up this most important work which has been so long neglected upon the chain of great lakes. I took occasion, during the life of Col. McDonald, to urge upon him personally, more than once, the necessity of undertaking this work and carrying it on under the supervision of the United States Fish Commission. They have an organized force of scientific men who can plan and carry on this work in the way it should be conducted, and you cannot marshal too many forces of that kind. It need not interfere with Illinois. Illinois may aid them and so they may aid Illinois. A great work of this kind, it seems to me, should be done here upon the great lakes. The act under which the United States Commission was organized provided that they should conduct such investigations as to the food fish in all the waters, not only of the ocean but of the great lakes. It was a simple statement but it means a vast amount of work. It must extend, as the professor has said, over years of inquiry, and how important it will be to fish culture. We are just awakening to it. Perhaps we have thought this over personally, but the society has taken up this question for the last three of four years in a way that it never has before. How important it is to know what the conditions are in the lakes influencing the successful planting of fish. Are there barren food areas? Are there areas abounding richly in fish food? When you speak of the land, and its cultivation; when you

speak of the aid that agriculture has received from scientific investigation, you recognize that that great work has aided the tiller of the soil. Whenever you broaden human knowledge by investigation, you have added very much to results. When you speak of a given area of land, and compare it with an area of water in its food producing power, and when you compare the cost of the production of the one with the cost of the other, the argument is in favor of the water. The soil is tilled, it is prepared for the seed, it is watched constantly, the crop is garnered, it is marketed, all at the cost of effort and means. But so far as the great waters are concerned from which fish food is drawn, the seed is sown and it grows to maturity under natural conditions and at practically no cost. What is the lift habit of the infant whitefish or the infant trout or any of the other numerous commercial varieties of fish during its first stage of life? Does the character of their food change when they become older? If so, what is their food after that change occurs? In what respect does it differ from the earlier stage? Do they forsake the spawning beds where they are naturally brought to life? If so, when, where do they go, what do they feed upon there? What are their natural enemies? All these things once solved add to the efficiency of the work of the fish culturiest, and this solution can only be wrought out by scientific men. Many investigations they make may seem remotely connected with fish culture, but it is not so. Look at the suggestion contained in Professor Reighard's paper, of that ever working cycle of existence and life. The lowest form that is washed into the lake basin in the nature of silt, is the food of the lowest forms of plant and animal life, they in turn are preyed upon by the next higher forms, those in turn serve as food for fish ,and man feeds upon fish, he dies, returns to dust and becomes the food of these lower forms, if you please, and so the cycle goes on and on.

I wish again to congratulate the fish culturists of the country upon the determination of the United States Commission to enter into this field of scientific investigation. So far as the States are concerned, I feel that any aid they can render will be cheerfully accorded. We welcome the U. S. Commission to the field, and it is one of those things which seem to me to go far towards commending a public officer that he proposes to take a step of this kind, even though it should have been taken long ago.

Mr. Tomlin: It gives me a great deal of pleasure to say that though Minnesota has done very little towards establishing any

such station of information, as mentioned by Professor Reighard and Professor Birge, I recognize its importance, and it does me great pleasure to confirm the statement of Mr. Clark, that the United States Fish Commission has sent out Professor Wymans, of our Duluth high school, the past two seasons to pursue just such researches as these.

The committee on place of next meeting then reported as follows:

Mr. Davis: The committee appointed by you to select and recommend a location for the next meeting unanimously recommend the City of Omaha.

On motion the report was adopted unanimously.

The Chairman: It is now in order to fix the time when the meeting shall be held. There is some force in what has been said about fixing a time, as nearly as we can, that will be a little further away from the college commencements, so that we can have the scientific workers with us.

Mr. Dickerson: I would suggest some time in the month of May.

Chairman Whitaker: Of course we should consult Mr. May somewhat in reference to this matter. There is another thing we want to look out for, and that is to put it far enough away from the season of fish distribution so we may be able to get the superintendents to attend.

Mr. May: The main reason for my asking the society to hold its meeting in Omaha next year is on account of our Trans-Mississippi International Exposition, which opens June 1st. We want the members of the society to be there after the exposition opens, on account of the exhibit we expect to make there, in the way of live fish, fish products, implements of fishing, etc. We want to make it on as broad a scale as we can possibly make it. While we don't expect to equal the exhibition at Chicago, we want to make it of as great magnitude as we can, as broad as possible. Since you have named Omaha for holding the meeting of '98 I beg of you to fix a date after the first of June, when the exposition will be in full operation. Our exposition runs until November, so any time during that period will be satisfactory to us.

Mr. Dale: I move that it be made the last week in June.

Mr. Peabody: I move to amend by making it the second week in July. I think business men, as a rule, after the 4th of July feel more at liberty to take the time. During June there is a sort of a closing up of affairs and getting ready for vacations, going into the country or whatever it may be, and it strikes me the second week in July would suit more people than any other time.

Mr. Clark: When I was on my feet before, I had in mind to offer a motion that we meet the third Tuesday in July. Your motion or suggestion of the last week in June must necessarily shut out a great majority of the superintendents of the United States Fish Commission. We are here on borrowed time really now. The United States Fish Commission superintendents at the close of the fiscal year are very busy in making up their reports. Our rules and regulations require us to have our reports in the Washington office on the 10th day of July, and business nowadays is very prompt in the United States Fish Commission, and it must be. If you want those men here you must have it a little earlier or a little later, and the state superintendents, I presume, are busy in the same way, perhaps not so much so, but to a certain extent, and I had in mind to move to make it the third Tuesday in July.

A Member: I will second Mr. Peabody's motion for the second week in July.

Mr. Peabody: I am willing to leave it to the Executive Committee, to put it any time after the 10th of July.

Chairman Whitaker: It would be an unsatisfactory thing to leave a matter of that kind to the Executive Committee. The society ought to settle this date itself, and it seems to me this is just the time to get the consensus of opinion as to what time we want to fix.

Mr. Clark: There is no very good reason, it seems to me, for having it so early. We are all aware that all the expositions we have ever had in this country, during the first two months did not amount to much.

Mr. Peabody: With the consent of the second, I will withdraw my motion.

Chairman Whitaker: The question now is on Mr. Clark's motion. The motion before the society is that we meet in Omaha on the third Tuesday in July, 1898.

Mr. Peabody: I think there is a point about Tuesday being pretty close to Sunday. It is a long distance out there, and it seems to me Wednesday would be a better day. I move you, as a substitute, that the meeting be on the third Wednesday instead of the third Tuesday of July.

The Chairman: As Mr. Clark has no objection to it, Mr. Peabody's amendment will stand as the original motion.

The motion was unanimously adopted.

Chairman Whitaker: We will now listen to the report of the committee on the suggestions contained in the report of Secretary Cheney.

The committee reported as follows through its chairman, Mr. Bryant:

The committee appointed to consider the report of the secretary, hereby report that having considered the same, they respectfully recommend the adoption of the following:

Resolved, (1) That the Secretary be instructed to furnish copies of the transactions of the society to any public libraries or historical societies or scientific institutions applying for the same.

(2) That the Secretary be authorized to procure a seal for the society, adopting the device of the association.

(3) To secure promptitude and accuracy in the issuance and publication of the reports of the society, it is urged that the proofs of all papers read be submitted for correction to the authors, and that they promptly read and return to the Secretary.

Mr. Preston: In order to make the report of the meeting read right, would it not be better first to receive the report, and then we can adopt such parts as we like. I move the report be received.

The motion was seconded and carried unanimously.

Mr. Titcomb: I move, Mr. Chairman, that the first section of that report be referred back to the committee, for correction and change after having heard the opinion of the members relative to the distribution of the report.

The Chair: The motion before the house now is the question of recommitment. It is moved and supported that the report be recommitment to the committee to consider and report again.

The motion was carried unanimously.

Mr. Dickerson: I have a resolution to offer here, handed me by Mr. Gunckel.

Resolution read, as follows:

By Mr. Gunckel:

With a view of getting a uniform law for the protection of fish in the lake states, I move that the chair appoint one representative, who shall be a member of this society, from each of the states bordering on the great lakes, as a committee for the purpose of laying the matter of fish protection before the officials of their respective states, to get ideas, suggestions and such facts as will lead to the framing of uniform laws to regulate the fisheries in all the lake states. The chairman of such committee to file his report with the president of the society on or before November 1st, 1897, when the president shall refer the report to the Executive Committee, who shall take immediate action.

Professor Birge: I move that the resolution be adopted.

The motion was supported.

Mr. Gunckel: As a matter of explanation, I will say my time yesterday was very limited here; I had to return to Toledo last night and came back this morning. During my stay at home I referred back to the records of the meetings for a number of years, and I discovered that at each meeting several hours have been expended in arguing on the object of this motion. As I have stated, by correspondence and personal conversations with some of the high officials of the United States, I have come to the conclusion that this matter, suggested last year by our present chairman, was the most feasible that could be adopted by this society. Because then it would introduce the subject and it would lead to harmony in the laws of the various States and the water belonging to the government. The government would then take some action for the lead, what we have been after for a number of years. This is a suggestion of President McKinley. He realizes the fact that the laws of the various States are in conflict, and it seems to me almost impossible for this society to work in any other way and gain that success which we have been after than this; to appoint one good representative from each State to hold consultations and discuss the matter with the officials of the various States, and it may open a field that may result favorably to this association, one of its leading objects. I emphasize that because I noticed in reading the past reports that that seemed to be one of the leading questions of the association;

the protection of the fish and the interesting of scientific men, who can spend a lifetime in study and hard work to assist us in getting more knowledge of our waters and to learn what is the best plan to protect them. I have talked and corresponded with a great many men during the past year. I took this matter up on my own account. I will not take up your time longer on the subject, but those who have been attending our meetings during the past will recall a number of arguments that have been presented from time to time, heartily favoring a movement of this kind.

The Chairman: May I ask you if you have heard of the action that has been taken in several of the lake States with reference to the matter this last winter by the legislatures?

Mr. Gunckel: Yes, I have. Since I noticed that, as I said, I have talked with the officials of the United States, some of the United States Commission, Dr. Bean and Dr. Henshall, and I heard indirectly from Mr. Stranahan, and the object is to bring this matter around through the American Fisheries Society. They are working well in the various States. They are trying to get that law. I see Delaware and Pennsylvania and some of the other States have it, but we should have our society not only meet once a year and then revive a little life when we get our reports, but we should have some work connected with it during the entire year.

The Chairman: Does your motion contemplate there shall be a representative from each of the lake states who is a member of this body?

Mr. Gunckel: Yes, a member of this society..

The Chairman: I did not understand your motion to so express it. I reported on that part of the work of last year in your absence. I did not act upon the motion of last year, because it was broader than your present resolution. It embraced the seaboard states and contemplated two committees, one for the great lakes and the other for the seaboard states. I wrote to Mr. Huntington, who is deeply interested in the matter, and asked him to send me a list of names. He sent me names, but some of them were not members of this society. It seemed to me that we would be going outside of our province to attempt to direct any one not a member.

Mr. Gunckel: I expected this would be a beginning and lead to the appointment of members from the seaboard states. I did not have time to properly form this so as to cover that.

The Chairman: I want to say for the information of you gentlemen who do not happen to know about the matter, that Mr. Bell, of Wisconsin, was the father of the movement I have referred to, and he is entitled to great credit for it. It seems there were introduced into the legislatures of Minnesota, Wisconsin, Illinois and Michigan this last year joint resolutions or concurrent resolutions providing for the appointment of representatives of those states to meet and decide upon uniform laws to regulate the fisheries. As I understand it, that is the scope of it, and each of these four states have acted on the matter. They will meet this coming summer.

The motion was seconded and carried unanimously.

Mr. Titcomb: To get it before the members before any more absent themselves, I move that when we adjourn we adjourn until two o'clock this afternoon, city time.

The motion was carried unanimously.

Mr. Bryant: The committee to whom was recommitted the secretary's report, wish to report that they have stricken out the words "for general distribution." I move the adoption of the report.

The motion was duly seconded and the report was adopted.

Mr. Davis: It strikes me it is a mistake to restrict to that extent the publication of the reports.

Mr. Peabody: I move as an amendment, that each member have an opportunity to make application for five copies of the report, and that they be sent to him if he makes application, otherwise but one.

The motion was carried.

Adjourned to 2 p. m.

PROCEEDINGS OF FRIDAY AFTERNOON, JUNE 18, 1897.

The session was called to order by the President.

The Chair: We will now listen to a paper by Mr. Seymour Bower, on Fish Protection and Fish Production.

Mr. Bower: Mr. President and Gentlemen of the Association. I have jotted down a few thoughts that I have put under

the head of Fish Protection and Fish Production, although I suppose any other title would do as well. We are all, of course, deeply interested in the question of producing the greatest possible number of the more valuable species, and we are all honestly and conscientiously endeavoring, I take it, to do all we can to bring about that result. No doubt there are some who will dissent from some of the opinions that I hold on some of these questions. I will only say that my conclusions are not hastily formed. They are the result of sixteen or seventeen years of practical experience.

FISH PROTECTION AND FISH PRODUCTION.

By SEYMOUR BOWER.

While we must in the future, as in the past, depend upon scientific research to indicate the best methods of propagating and cultivating water life, yet many of the complex and intricate problems that spring from a consideration of fishery economics are of minor importance when compared with the practical and less difficult questions that arise. These minor considerations differentiate in endless ramifications, affording a broad and interesting field for the scientist and investigator. Water life, from its lowest forms up, is a mysterious maze of combinations and possibilities, involved in which are many paths that will never be explored and many secrets that will never be disclosed.

But though many of these intricate problems shall never be solved and the door to a perfect knowledge of the interrelations of water life shall remain forever barred, yet we are no worse off than the ignorant but thrifty husbandman, who, with the simple knowledge of when and how to sow and when and how to reap, secures almost as large a crop as though he understood to a nicety the combination and relation of every element and process of development.

The term "fish protection" is a deceptive generality that may mean much or little, but which is quite apt to lead the unthinking into the error of supposing that in order to carry the annual production of mature fish to the highest point, the privilege of catching them must be surrounded at every turn with nearly prohibitive restrictions, whereas, protection in its truest sense and in its true relation to production, seeks to provide an increase, not decrease, in the annual harvest of adults. The real problem, therefore, is to determine what measures shall be adopted to enable us to remove the largest possible number of mature fish from the waters each year without depleting them.

Fish life is surrounded, perhaps to a greater extent than any other form of animal, with natural enemies and dangers that imperil existence at every stage and every turn. Nature, of course, has provided for each some means of defense or escape; but there is incessant warfare and destruction from the moment the ova are laid—indeed, with many species by far the greater part of the destruction is wrought during the ovum stage. Each

species is an enemy of all others, oftimes of its own. The spawning grounds of every kind of fish are likewise the feeding grounds of others, the spawn itself constituting the food; and every kind of the larger species is either a fish destroyer or spawn destroyer, or both, at some stage of life.

Of course, this preying of one form of animal life upon another begins much lower down the scale; in fact, the abundance or scarcity of the highest forms, or ultimate product, is determined by the volume of the lowest or fundamental forms. But the building up process finally results in populating the waters with a variety of animals suitable in size, form and texture as food for man. These animals embrace many species, some of which are prized far more highly than others, but all are alike without value to mankind until caught, and the importance of any water as a source of food supply depends, not on the number of animals inhabiting it, but on the annual output of adults of the more highly prized species.

Opinions will vary as to the number or proportion of adults that may safely be removed each year, but no one will deny the proposition that all of the adults of any species might be caught out each year as fast as they come to full maturity, provided that a sufficient number of young of the same species were reintroduced each year to make the loss good. Through the medium of artificial propagation, which protects the ova that nature leaves unprotected, this compensation of young is entirely feasible with the shad, the salmon, trout, whitefish, pike-perch and some other species, provided always that the catching and killing of the young and immature fish is absolutely prevented.

Where artificial propagation is thus able to supplant natural propagation, thereby eliminating the latter from consideration, it is much better to catch off the adults as fast as they mature, and thus make way for succeeding crops or generations. When fish have matured, it is time, so to speak, to realize on the investment. They should then be converted into food, either for some other fish, or for man. If allowed to remain, they defeat the very object for which they were created, namely, to be caught and utilized. The food which they consume by remaining should all be converted into increment by going to the young and growing fish, instead of being wasted on the adults merely to prolong their lives. When a female fish has matured and yielded a crop of ova to the saving process of artificial propagation, she has accomplished more in the way of reproduction that she could

in hundreds of seasons under natural environment, and can therefore well be spared.

It is evident that restrictive measures need not apply to the adult fish, provided a sufficient number are available for artificial propagation, but as affecting the young and immature fish such measures should be of the most stringent character. The killing of young fish of the more valuable species is little short of criminal, and should be penalized in every possible way.

A little reflection must convince anyone that natural propagation is entirely inadequate to keep the waters stocked to their limit if considerable inroads are made in the parent stock at any season of the year, and it is a vain hope to expect nature to recover and hold lost ground by nature's methods alone, unless the waters are closed absolutely and permanently.

It is true that the catching off of one kind of fish sometimes results in increased production of others, and without the aid of artificial propagation, but such increase cannot be relied upon as being permanent, and depletion is sure to follow if fishing is continued and no restitution is made through the agency of artificial propagation.

The history of fishing waters is replete with illustrations and examples to prove the proposition that the natural hatching percentage of many species is too insignificant to offset any considerable drain on the parent stock. How often we hear the remark, "There used to be mighty good fishing over in Smith Creek, or Jones Lake, but they are pretty well fished out now." Even our best trout streams, after having been stocked to their limit, sooner or later become depleted unless kept up by occasional contributions from the hatcheries, and this, too, notwithstanding that the fishing is limited to hook and line and the season is closed two-thirds of each year. The reason for this is that it is impossible to recoup from the fish taken in the *open* season, and equally impossible to protect from natural enemies the ova deposited in the *closed* season. The unripe spawn in the adult fish caught in the open season is hopelessly and irretrievably lost, while the ripe spawn deposited in the closed season is very largely so.

Natural propagation will never force a water to its highest productive limit, unless fishing is absolutely prohibited for an indefinite period. Fortunately, this course is not necessary, for while we cannot prevent more or less destruction of one kind or size of fish by another after they leave our hatcheries, we *can* and *do* save the enormous waste that occurs under natural

conditions during the *ova* stage, and thus bring into existence immensely increased numbers of young fish. To appreciate fully the significance and importance of artificial propagation as a factor in fishery problems, we must ever keep in mind this wonderful margin of gain over natural propagation.

Fish culturists and all who have carefully investigated the subject are unanimously agreed that the treatment and protection we extend to the ova multiplies hatching results five hundred to one thousand times, and some place the ratio much higher. Nor is this enormous disparity to be wondered at when we inquire into the conditions, and understand the dangers and perils to which the spawn as deposited in nature is constantly exposed.

But taking the most conservative estimate, five hundred, as a basis, and it will be seen that we produce as many fish from one pair of adults as nature does from five hundred, or that one million ova artificially treated is equal to half a billion on natural spawning beds. Or, to put it another way, five hundred pairs of breeders must be allowed to reach their spawning beds and spawn undisturbed to accomplish what we are able to, simply by lifting a single pair from the same beds and submitting the ripe ova to the treatment and protection called artificial. While the ova on spawning beds has its uses in the economy of the waters, serving, as it does, as a source of food for other fish, yet so far as reproductive results are concerned, 499 out of every 500 pairs may as well never spawn at all, provided always that the solitary remaining pair falls into the hands of a hatchery expert at the proper time. It will readily be seen, therefore, that compensation for the removal of adults is possible only when they are taken from spawning grounds, and absolutely impossible only when taken elsewhere.

It should not be inferred that an indiscriminate throwing down of the barriers to the capture of adult fish is advocated. Many species of fish guard their spawning beds and protect their ova and young from the ravages of natural enemies, performing functions that correspond with the parental care and solicitude of land animals, thus producing a large natural increase. These should be surrounded with all manner of safeguards and afforded the most ample protection during their breeding season.

But there are many species of fish whose ova yields readily to the methods of artificial propagation, that desert their spawning grounds the moment the spawn is cast, leaving the defenceless germs wholly unprotected, to be mercilessly destroyed by by a hungry horde of spawn eaters. Now, when fish of this class

assemble in sufficient numbers at the proper time to permit the collection of enough spawn to recompense the annual capture of adults, or, in short, whenever and wherever it is possible and practical to make complete restitution, it is obvious that no restrictions are needed. Desirable species that shirk parental duties after throwing their ova should not be allowed to throw it; they should be headed off and forced to "cough up" in time to give the germs the treatment and protection that they deserve, instead of being allowed to go very largely to waste.

If all the salmon and all the shad that ascend our great rivers from the sea were allowed to reach their spawning grounds before being caught, the immense numbers of young that, by the grace of artificial propagation, it would then be practical to return, would soon restore the depleted waters to their virgin fruitfulness. Fishing would be concentrated to fewer points, but the aggregate annual production might thus be greatly increased, and maintained indefinitely. If these propositions are not true, then artificial propagation is a snare and a delusion and should be discontinued.

It must not be inferred that any relaxation of the protection now afforded our trout streams is to be thought of. Circumstances alter cases. We are obliged, in Michigan waters at least, to close the spawning season for brook trout and leave reproduction to nature's wasteful methods, simply because the parent fish are distributed throughout innumerable spring tributaries, making it impossible to collect the ova in paying numbers at any one point. It is a matter of the keenest regret, however, that all of the wild trout of spawning age in Michigan waters cannot be assembled each spawning season, and their ova submitted to the multiplying process of artificial propagation. There would then be no unfilled applications, no unstocked streams, for the immense production of fry each season would keep every stream stocked to its limit for all time to come.

But this, of course, is impossible, so the only alternative is to confine a stock of parent fish in ponds, simulating natural surroundings by providing an inflow of spring water over a gravel bottomed raceway into which the gravid fish are enticed. But we do not allow the fish to spawn naturally, knowing as we do by actual trial, how meagre the results would be. Nor should any fish of this class be allowed to spawn naturally, whenever it is feasible to take advantage of the saving economy of artificial methods.

The most effective methods of fish protection, then, must include protection of the ova. Protect the spawn as well as the immature fish, and there will be an abundant harvest of adults; and the universal recognition and application of this principle will greatly enhance the value of some of our most important fisheries. Protecting the adults from the hand of man, instead of catching them and protecting their ova from the ravages of natural enemies, is a striking example of "saving at the spigot and wasting at the bung."

Mr. Nevin: I fully agree with Mr. Bower in his statements, and I do not think he has made it strong enough. I do not think one egg in a million that is laid naturally in Michigan in the lakes, of the lake trout or whitefish or wall-eyed pike, will hatch. Not one in a million, naturally.

Mr. Stranahan: I indorse every word Mr. Bower has said in his paper.

The Chair: We will now listen to the report of the Memorial Committee.

Dr. Parker made the following report for the committee:

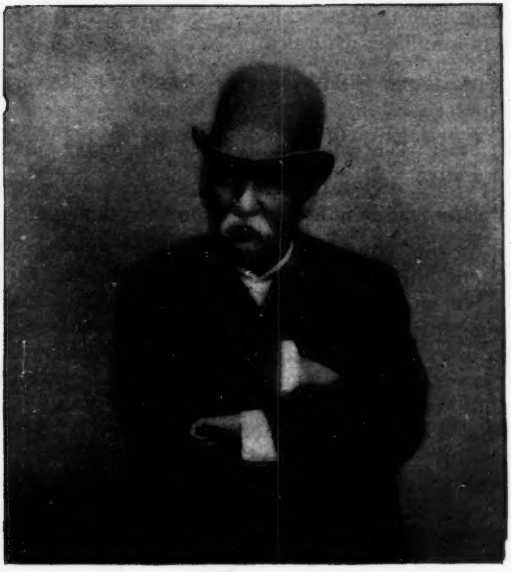
When in the regular sequence of Nature's laws, our friends pass out into the dreaded silence, having fulfilled the allotted period of life, such a going out always comes to us like a seeming disaster, for it is hard for the affections to recognize the great fact of existence that it is just as much in accordance with Nature's laws to die as it is to be born But when we can so far philosophize we can better accept the startling fact when it is brought home to us, and so in the death of these brothers of ours, whose memories we delight to cherish, let us remember that they have passed out from among us, not through any dispensation of Providence, but in strict accordance with Nature's inexorable laws. But the great ethical fact of life is, not how long in years we may live, but how well we may live in deeds and words that bring joy and comfort and happiness into the lives of those around us.

To those of this society who have known our deceased brother, Marshall McDonald, no words are necessary to tell how well he fulfilled the ethical law. Kind and considerate of the feelings of others, always a courteous and dignified gentleman, he not only commanded respect for himself, but inspired self-respect in others. While his scientific attainments in the direction of his chosen

life's work, he commanded the respect of his co-temporaries. It, also, has been of value to the world.

No higher tribute could be paid to the memory of Dan Fitzhugh than the words of your President, "He was one of Nature's noblemen, a true sportsman, a brave spirit, with a heart as gentle as a woman's." And to this let us add these words from the Persian poet:

> "And when * * Oh, Saki, you shall pass,
> Among the guests, star scattered on the grass.
> And in your blissful errand reach the spot,
> Where he made one, turn down an empty glass."



D. H. F. FITZHUGH.

Of Brother H. C. Ford, his connection with this society is a matter of record, having served as its President, and for several years as its Treasurer. Born to an ample inheritance, he was so placed in life that he was enabled to satisfy his love for the "gentle art" that became to him almost the fullness of life; fish and fishing, and those who fished, were the chief sources of his en-

joyment, and those who have listened to his quaint and quiet wit and humor, and enjoyed his "fish stories," will always treasure them as bright spots in memory. Quiet and unostentatious, he possessed the true spirit of one close to Nature's heart, and one always in touch with her beauty and her truth, and one so loving nature loves his fellow man.

JAMES A. DALE,
J. C. PARKER,
H. W DAVIS.

The report of the committee was accepted, adopted and ordered printed in the proceedings.

Mr. Dale then read a memorial of Mr. Ford, presented by Mr. William B. Meehan, of Philadelphia, which follows.

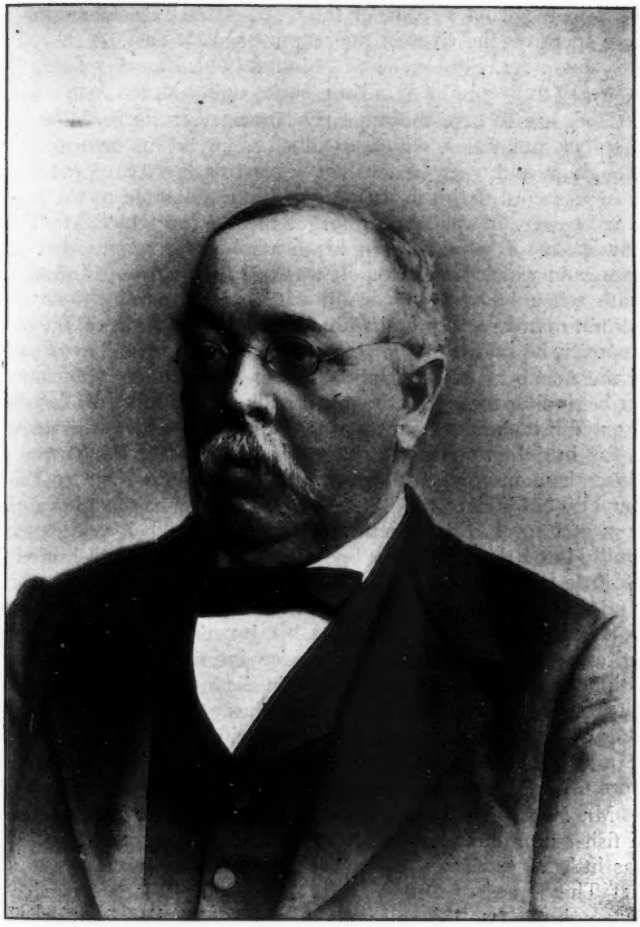
HENRY C. FORD.

By WILLIAM E. MEEHAN, Philadelphia, Pa.

Probably no man was better known among fish culturists, in this country, than Henry C. Ford, and no man was more greatly esteemed for his knowledge of the subject of fish culture and for his qualities as a man. His modesty and unassuming ways made him a general favorite among those with whom he came in contact, and gained for him the respect of those who knew him by reputation only. By his death Pennsylvania's fish cultural work suffered a severe loss, and people all over the United States were deprived of a friend. For some years Mr. Ford had been a sufferer from the disease which finally resulted in his death, but he bore his affliction so bravely and so patiently, that only those who were nearest to him, were aware of his trouble until a few months before the end. To a large number of his friends the announcement of his demise was a sudden and unexpected shock.

Mr. Henry C. Ford was descended from old New York and Connecticut stock, although he himself was by birth and residence a Philadelphian. He was born July 25th, 1836, his father, Isaac Ford, being at that time one of the largest wholesale dry goods merchants in the city. He was the first born, and on the death of his father became the manager of the estate, which was very large. Beyond this Mr. Henry C. Ford was never engaged in business, his father having retired some years before his death. His preliminary education was received in private schools in Philadelphia, and it was completed at Brown University, from which institution he graduated in 1856. Among his classmates were several afterwards notable men, prominent among whom were ex-Secretary of State Richard Olney, and General Tourtelote.

From boyhood Mr. Ford was fond of angling, and was early the companion of some of the most noted anglers of the day. Having abundant means, he was able to indulge to the full in his favorite sport, and in pursuit of it, at various times visited and fished nearly every noted river and stream in the country. During the latter days of his life, however, he spent most of his fishing days in Florida and at Egypt Mills, Pike County, Pa. While extremely fond of trout fishing, Mr. Ford's favorite sport was the capture of the black bass. He was probably the most expert



HON. HENRY C. FORD.

angler for this species of fish in Pennsylvania. He was, moreover, as indefatigable at it as he was enthusiastic. The Delaware river flowed only a few hundred yards from the cottage where Mr. Ford spent the summer, and where he spent the last days of his illness, and every day except Sundays, or those on which he de-

voted to the trout stream, or the work of the Fish Commission, were spent on the river in the search of black bass. A thorough sportsman, Mr. Ford made a resolution (which I never knew him to break) to keep no fish of this species under eleven inches long.

He grew to love the upper Delaware, with its beautiful surrounding mountains, almost as much as he did his favorite sport of angling, and when he felt that his last days were approaching, he expressed a desire to be buried within the sound of the music of its waters. I shall never forget the day on which Mr. Ford first spoke of what was in his heart in this respect, nor the manner in which he did so. It was less than a month before his death when he sent to consult with me concerning some fish cultural matters which he had in mind. When the main business was over, he said to me in that quiet, even tone familiar to many of the members of the National Fisheries Society, "Meehan, I am beginning to feel as though my illness will have a fatal ending, and if it should I want you to convey my wishes with respect to my burial to my family. I tell you because I don't want to cause them unnecessary worry now, by leading them to think that I do not believe I will recover. There is a handsome mausoleum at Laurel Hill Cemetery, in Philadelphia, belonging to my family, but I don't wish my body laid there. I want it buried in the little graveyard on the hill back of Dingman's Ferry, which overlooks the stretch of the Delaware river where I have fished for twenty-five years." He had his heart's desire. When the end came, his body was taken by a few intimate friends only, and with no pomp was laid reverentially in the little churchyard on the hill from which can be seen the sparkling pools and be heard the song of the long rifts of the Delaware river. No thought could be more poetic or more characteristic of the man; nor could a more fitting resting place have been selected for his remains.

Mr. Ford's expertness as an angler, and his broad knowledge of fish cultural matters, brought him into prominence while he was little more than a young man. For some years it was felt that The Board of Pennsylvania Fish Commissioners needed a thorough overhauling and new life put into it. Without solicitation on his part, a number of friends urged him strongly for the position of Fish Commissioner, but through some misunderstanding, the appointment was not given him, and it was not until General Beaver was made Governor of Pennsylvania that Mr. Ford received his appointment. His work was admittedly so valuable that successive executives reappointed him, his last commission coming to him on his sick bed.

Mr. Ford threw himself into the work with an enthusiasm which, together with an exercise of common sense, soon raised the reputation of the Commission to an equality with the best of other States. Soon after his accession to the Commissionership he was chosen its President, a position which he held until his death. Among the questions of importance which came before him for a settlement and action, as far as Pennsylvania was concerned, was the most suitable age, other things being considered, for the Commission to send out trout fry for planting. After careful thought he became a strong advocate of a four months old period. He held that if the recipient of trout fry planted them properly, fully as good results would follow as though the fish were what are commonly called yearlings. Properly planted four months old trout, he claimed, were abundantly able to care for themselves. Naturally there were many people in the State who differed with him on this question, but as a rule he had the support of those who took the most active and intelligent interest in the work of fish planting, and his policy was endorsed and carried out by the Commission.

One of the greatest ambitions of Mr. Ford was to firmly establish the Atlantic salmon in the Delaware river and form therefrom an industry which would rival that of the shad. An effort had been made in 1870, and a few subsequent years by the late Thaddeus Norris and a few friends, but they soon abandoned their labor in this direction as a failure, although for years after a salmon or two came into the river each season to spawn. Mr. Ford felt there was no reason why this great food and game fish should not do well in the Delaware river. He held it to be an ideal stream. Its waters are pure, and it has numerous fine tributaries of cold water suitable in every way for the fish to spawn in, and there are magnificent pools and reaches the whole length of the river, above Trenton. He held that the failure on the part of Mr. Norris and others to achieve striking success, was not owing to any unsuitable qualities in the river, but through the fry not having been planted in the right places. Mr. Norris deposited the young salmon in the Bushkill creek, near Easton, only about fifty miles above tide water. Mr. Ford regarded the fact that any salmon survived under these circumstances as indisputable evidence that the Delaware is a suitable stream for the fish in every way. Instead of planting the fry in the lower part of the upper river, he had them taken as far up as the New York State line and placed in such streams as the Dyberry and Equinunk. He followed the first planting in 1890 by others each year

after, except two, when no eggs were obtainable. The soundness of Mr. Ford's reasoning was shown in 1895, when nearly a hundred salmon were caught in nets. The results were so gratifying that last year the United States Fish Commission ordered an investigation to be made by the agent taking an account of the shad catch. This official found that in 1896 nearly $2,000 worth of salmon were taken by the regular fishermen alone, and that there was reason to believe that many fish had been captured by other parties not regularly engaged in professional fishing.

Mr. Ford died before the figures could be given him, but he lived long enough to feel that he had demonstrated the possibility of making a great salmon river out of the Delaware. He felt it to be his greatest triumph, except, perhaps, the part which he took in making the river the greatest shad stream in the United States, with the possible exception of the Potomac. Mr. Ford, with his characteristic modesty, rather under-rated the importance of the part which he took in this great work, but others who were associated with him in the labor, or who are familiar with the circumstances, are confident that the ultimate and complete success was largely owing to his energy and determination. When Mr. Ford became Commissioner he found the Delaware and Susquehanna rivers full of fish baskets and other destructive contrivances for catching fish. He discovered before long that the task of ridding the Susquehanna was, for some years to come at least, a hopeless task. Maryland owned some thirteen miles of the river, and by her laws permitted fish baskets and similar contrivances calculated to destroy all the valuable fish. There were also several large dams over and above which the shad could not pass. But what was more discouraging than all was his discovery that the sentiment of the people along the Susquehanna, including most of the legal officials, were in open and active sympathy with the lawless element and against the work of the Fish Commission.

In consequence of these things Mr. Ford determined to devote his efforts mainly to the Delaware, where he would have the active aid of the Fish Commissions of New York and New Jersey. By united action the Delaware was soon cleared of all serious obstructions and of every illegal device, in spite of bitter opposition on the part of the fish basket men. As a result of this work the catch of shad in the Delaware now reaches a half million dollars in value at the nets every year, while that of the Susquehanna has sunk to barely $20,000 a year.

For five years Mr. Ford was Treasurer of the American Fisheries Society, and in 1893 was its President. He was also a member of a number of angling and fish protective associations, on all of which he left the stamp of his energy and enthusiasm.

When the United States and Canada determined to make an effort to adjust the differences which existed between the two countries over the fish laws, Mr. Ford was made one of the Commissioners. The international body was in existence for about two years, and it was one of the disappointments of his life that little of value to the two countries was accomplished.

Mr. Ford never became a candidate for any public office but once, and that was shortly after the death of Col. Marshall McDonald, United States Fish Commissioner. He then stated frankly that he had an ambition for the office and made an effort to secure it. He was backed by many powerful friends, but long before President Cleveland came to any decision in the matter, a sudden and alarming turn in the condition of Mr. Ford's health compelled him to withdraw as a candidate. This was in the beginning of the winter of 1895-96, and less than a week after his withdrawal as a candidate for the United States Fish Commissionership, he was confined to his house by what proved to be the last and successful onslaught of an illness from which he had suffered more or less for many years. Between December and May, Mr. Ford was able to leave the house but two or three times. In the latter month he was taken to Egypt Mills, where he was at last beside his beloved river, which, through his fostering care, had become famous for its commercial and game fish. He died on the 17th of August, a few days after an operation at the German Hospital in Philadelphia. Six weeks before his death he visited the river and fished for the last time, and there was something pathetic and deeply touching in his behavior on that occasion and which illustrated forcibly how deep a hold fish culture and angling had upon him.

I had been through a large portion of the State, engaged in investigating some fish cultural work and other matters for the Commission, and one evening in the latter part of June went to visit Mr. Ford and to report the results of my investigations. For a week or more before my arrival he had been bedfast and low-spirited, and his family thought it best to keep from him knowledge of my arrival until the next morning, fearing the excitement of it would be injurious. Their precautions were in vain, however, for he heard me come in the house and would not be satisfied until I had been brought to him

and he had heard the results of my journey. These, fortunately, were of a satisfactory character, and he went to sleep that night in a much more cheerful frame of mind than for some time previously. The next morning, to the suprise of all, Mr. Ford appeared at the breakfast table and announced his intention of going to the river to fish, and in spite of protests he did slowly take his way to the river, accompanied by his wife ,and there he was rowed about for a few hours while he fished. He was so weak then that the last of three or four medium-sized bass so thoroughly wearied him that assistance had to be given for the landing. This relation may seem to some to be trivial, but it is a striking illustration of the passion which dominated nearly the whole of his life, and which led him almost with his dying breath to request that he be buried on the little hill overlooking the river and the stretch of water that he had fished for twenty-five years.

Mr. Ford was an enthusiastic fisherman of the best type. He loved all that was good in the world, and while he hated and despised evil, he neither hated nor despised those who, through environment or other causes, committed evil. He pitied the being while he abhorred the act. It has been my lot to be brought into contact with many and diverse phases of human character, but I never intimately knew a man with a purer life or a better nature. A great city daily, in commenting editorially on the death of Mr. Ford, likened him to Isaac Walton, the greatest exemplar of the gentle art. It was a happy thought and an apt comparison. There was a remarkably close resemblance between the two as we are fond of picturing the mind and character of the great English angler. Mr. Ford lived his life as a good man should. He tried to do good for his fellow man and those who came into contact with him were the gainer thereby, and the world was the better for his having lived in it. His death caused a distinct loss to fish culture.

President: It seems to me that Mr. Ford's life and character have been so fully presented in Mr. Meehan's paper that nothing further remains to be said. Mr. Ford was a member who devoted much of his time to the success of the American Fisheries Society, and he was a member whom we had all come to respect, and his memory is one we shall all cherish.

We will now listen to a paper by Mr. J. W. Titcomb on the Collection of Wild Trout Ova; Methods of Collection and Utility.

WILD TROUT SPAWN; METHODS OF COLLECTION AND UTILITY.

By J. W. TITCOMB.

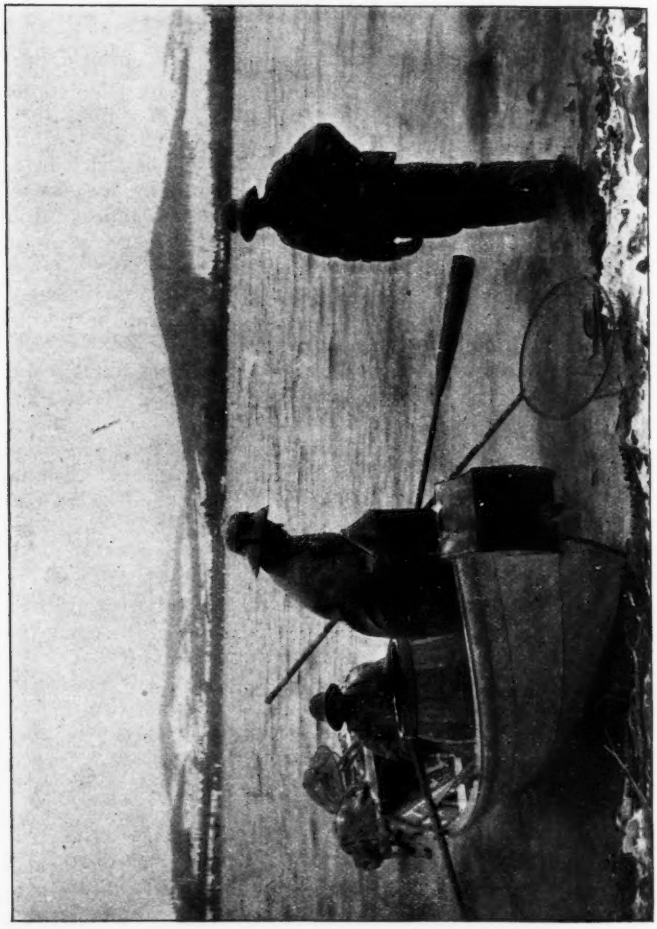
The method of securing an ample supply of wild brook trout spawn is so easy in localities where the parent fish abound, and so little has been said about this feature of trout culture, that I make bold to give my experience in this work.

Perhaps I should apologize for describing in an article before this Society a method of fishing of ancient origin which has for many years been applied by fish culturists to the capture of trout, fontinalis and anadromous fishes, but I have never seen this method written up in detail as modified for the capture of trout, and it seems a necessary part of a chapter on trout culture under the title on which I have written. I have reference to the first method I shall describe for the capture of the parent fish.

It is well known to all fish culturists that trout vary in their habits of spawning, or, rather, in their selection of spawning grounds. While brook trout in brooks almost invariably ascend to some point beyond their natural abode, or into some spring brook tributary to the main stream, it is not always the case that brook trout in lakes and ponds seek the tributary streams for their spawning grounds. It has been my experience that brook trout living in ponds quite as frequently spawn in them as in some tributary stream, even if the latter apparently affords good spawning grounds. In Vermont, the earliest run of trout begin to spawn about the middle of September, although they have begun to seek suitable spawning beds at least a month earlier. It is therefore necessary for the fish culturist to guard against the ascent of the fish long before he is ready to trap them if he is looking for stream spawners. This is accomplished by the use of a weir stretched across the stream where the trap is to be located, as early as the middle of August. As this weir can be used as the upper side of the proposed trap later in the season, it is desirable to construct it with that object in view.

Location.—The location of a trap should be made at a point where it is least likely to be inundated or washed out by freshets, which would allow the escape of many fish when they are most likely to be running in greatest numbers. A point on the stream near its mouth is advised, or at some place below any

possible spawning bed, but not near enough to the outlet to be affected by back water from the pond. It is desirable to have a slight fall of water at the entrance to the trap. In order to avoid washouts, the selection of a point where the channel is broad



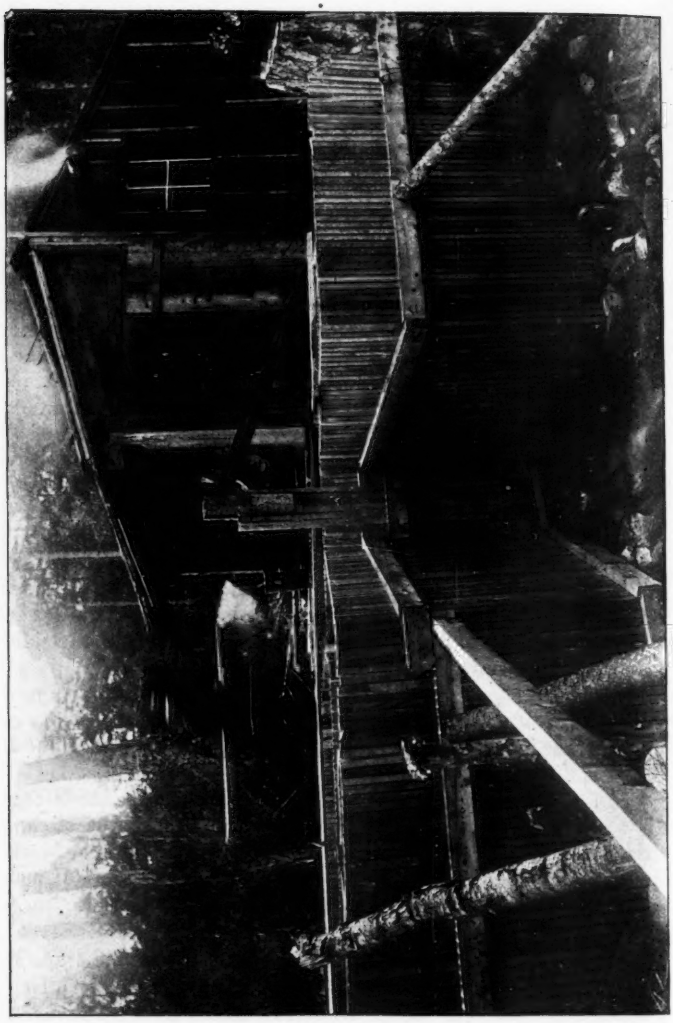
EQUIPMENT FOR TAKING WILD TROUT FROM THEIR SPAWNING BEDS AT NIGHT.

is preferable. The slats of the weir occupying about four-fifths of the natural waterway, will act as a barrier to raise the water above its natural level, more or less.

Construction—The trap is a V-shaped enclosure described by the mathematical term, "re-entering polygon," made of slats varying in dimensions with the size of the stream and the force of the current. I used slats one inch square, planed on two sides, driven into the bed of the brook vertically, about one-fourth of an inch apart, and nailed to horizontal timbers or hewn logs. This framework of horizontal timbers consists of one course laid at water level and a parallel course at the extreme height of the weir. The general idea of such a trap is the same as the pound net, there being an opening of four or five inches in the angle of the V. A gate can be arranged in the entrance with a lever reaching to some point obscured from the view of the entrapped fish, which can be lowered whenever the trap is approached for inspection. This method of trapping trout is not new, but requires more precautions than for the capture of other fish less active and gamy, and a few words of caution to the inexperienced may be desirable. Build your trap to resist the greatest freshet the stream is liable to develop. The run of trout at such times will be greatest. Be careful to get a foundation that will not be undermined by the constant washing of the current between the slats. It is usually best to entirely surround the sides of a trap with slats rather than to depend upon the natural embankments. It is not necessary to use narrow slats for the sides of the trap, as no water passes through them, and the only object is to secure an enclosure from which fish can be easily dipped out. For a stream six feet wide, I should build an enclosure about six feet square, the V extending into the enclosure about three feet.

In many localities it will be found possible to dig side ditches above the trap and enclosures, at right angles with the stream, in order to convey surplus water away from the trap and lessen the danger of washout or inundation. The bottom of such ditches should be considerably above low water mark to carry off surplus high water.

A convenient place for the pens is just above the trap, so that the trout can be dipped from the latter into the former. They are constructed of the same material of which the trap is made, the upper side of the trap enclosure being used as the lower side or end of a series of pens. These should be made in shape



VIEW OF TRAP SHOWING ENTRANCE FOR BROOK SPAWNERS.

and size to suit the location and number of fish expected to be captured, and the same precautions should be taken with them as with the trap to guard against washouts. In many instances, the bed of the brook is hard gravel and stones of large size, preventing the driving of the slats into it. In such cases it is desirable to make an apron at the base of the slat-work upon which the water will fall as it passes through them and prevent washing out of holes underneath the slats. This apron can be made of boards as an artificial bottom to the trap or pens, but a cheaper and quite as serviceable method is to place evergreen boughs or green underbrush at the base of the slat-work, covering the same with crushed stone or small stones from the bed of the brook, and then with coarse gravel. This feature of construction is very important. If there is a hole in the trap or pens large enough for trout to escape, they will surely do so. In fact, they will dig out under the slat-work if not properly guarded against. It is well to have planks extending over the trap and pens on which one can conveniently stand to dip out the fish. Adjacent to the trap and pens, a rough board shanty can be constructed or a tent can be temporarily used. There will be many stormy and cold days, however, and I advise having a shanty with facilities for heating it, and with a bunk where the attendant can sleep. Add to this equipment a reflecting lantern. Field stations of this description are usually some distance from habitation and the ordinary comforts of camp life should be available to insure good work of the spawn taker.

I have described one of the field stations operated by the U. S. Fish Commission in Vermont. The accompanying photograph gives a more distinct idea of it. The cost of such a station equipped for work will vary from $30 to $100, according to facilities for obtaining materials of construction, etc. At this station the first run of trout occurred on Sunday, August 23, when 1,650 trout ascended the brook during a rain-storm. Few trout were caught after this date until Sunday, September 6, when about 1,000 more were taken. On September 11 my records show that 3,335 trout had thus been taken. The fish continued to run in schools every rainy day, with a few stragglers every day until the end of the month. October 15 some of the slats to the trap were removed after 7,138 trout had been captured. There is no other tributary to the pond where these trout could run, except in the wet season. In the latter part of September it was discovered that a large number of trout were ascending a "dry brook," so called, in large numbers. At the request of the

owners of the pond, these trout were not disturbed, although it is doubtful whether their spawn would ever amount to anything deposited in such a stream. The discovery was occasioned by the fact that the trout had stopped running in the stream in which the trap was located, the inference being that they had learned of their danger and sought new spawning grounds. Whether such is the actual case, cannot be decided until after another season's work. The pond from which these trout ascended into the trap is an ordinary mill pond of about forty acres, used to float logs into a mill, and with no screen at its outlet. The trout average about five to the pound, and the females of this size yield an average of 560 eggs. About 1,000,000 eggs were taken here, a part of which were eyed in a tent supplied with water from an adjacent spring, a part being transported to the St. Johnsbury station as soon as stripped. In connection with a collecting station distant from the hatchery, it is advisable to have a few troughs set up for eying the eggs before transportation, if suitable water can be obtained for the purpose. The natural brook water is ordinarily of low temperature and too full of sediment to warrant using it for such temporary work. If an adjacent spring is available, troughs can be set up in a tent or shanty and the eggs thus eyed in from thirty to forty days before the most severe winter weather sets in. For this work I use deep troughs and stack the trays ten deep. The first stripping of eggs occurred September 26th, when 66,000 were taken. The second and largest stripping occurred October 7th, when nearly 500,000 eggs were taken, and the trout had all been stripped and liberated on November 7th. During the season only eighteen trout died. The cost of operating this station during the season, including team hire and transportation of eggs to St. Johnsbury station, was $256.83, exclusive of services of one regular station employe two months. This cost included the cost of construction of trap and shanty, some of which would not enter into the expense of another season. For this privilege of taking trout liberal returns are made to the waters in fry.

Lake and Pond Spawners.—The method of taking trout from spawning beds in ponds differs materially from the method just described. The following is a description of a field station and methods of operation where the trout spawn in the lake:

One of the first important features is to have suitable retaining pens in the lake where the trout will be undisturbed and secure from poachers. I am describing a station at a lake of 1,500 acres area, subject to high winds and rough water. The first

year that collections were made at this station a breakwater was constructed of lumber and stones as a partial shelter to the retaining crates, the latter being anchored in shallow water and weighted to the bottom so that they could be approached by a walk from the shore where a small tent had been erected in which to strip fish. The crates were always a source of annoyance for fear they would be robbed or broken up by high winds. The fishing was conducted in calm weather, day and night, and the stripping in stormy weather. Lake or pond spawners usually deposit their spawn later in the season than the brook spawners, and the weather is inclement for outdoor work such as stripping trout. As a result, the percentage of eggs eyed at this station was not what it should have been. The following season a boat house was constructed with retaining pens within it and of sufficient size to give ample room for spawn-taking operations. In this house a stove was set up, and thus the work of taking spawn could proceed without discomfort during the most severe weather of November and December. Of the eggs taken at this station last season, 97 per cent. were successfully eyed. The feature about the boat house to be considered in connection with the work, aside from the comfort of the employes, is the method of building retaining space for the brood fish. Two piers were constructed about six feet wide by twenty-four feet long, and laid parallel to each other eight feet apart. The material for the piers consisted of water-soaked logs taken from the lake, with the addition of a few trees cut near by. The logs were piled crib fashion, fastened with drift bolts and filled with large stones. The two piers were tied together at each end by stringers of logs, and constituted the foundation upon which the boat house was built. The space between the two piers or the inlet to the boat house was occupied by four crates, each six feet long by four feet wide by four feet deep. The log piers are not at all watertight, only large stones being used to sink them, and with the eight-foot opening at the sea end of the boat house, furnish ample opportunity for aeration of the water in the most calm periods. To guard against heaving by ice, which freezes two feet thick on the lake, the outside of the cob piers was covered with planks fastened vertically but sloping out in the form of a battered wall, so that the ice cannot get a hold on the piers sufficiently to move them. The planking should not extend but a few inches below low water level or it might interfere with the aeration of water in the crates. The trout were thus free from poachers, and also from the prying eyes of curious people. It may be remarked

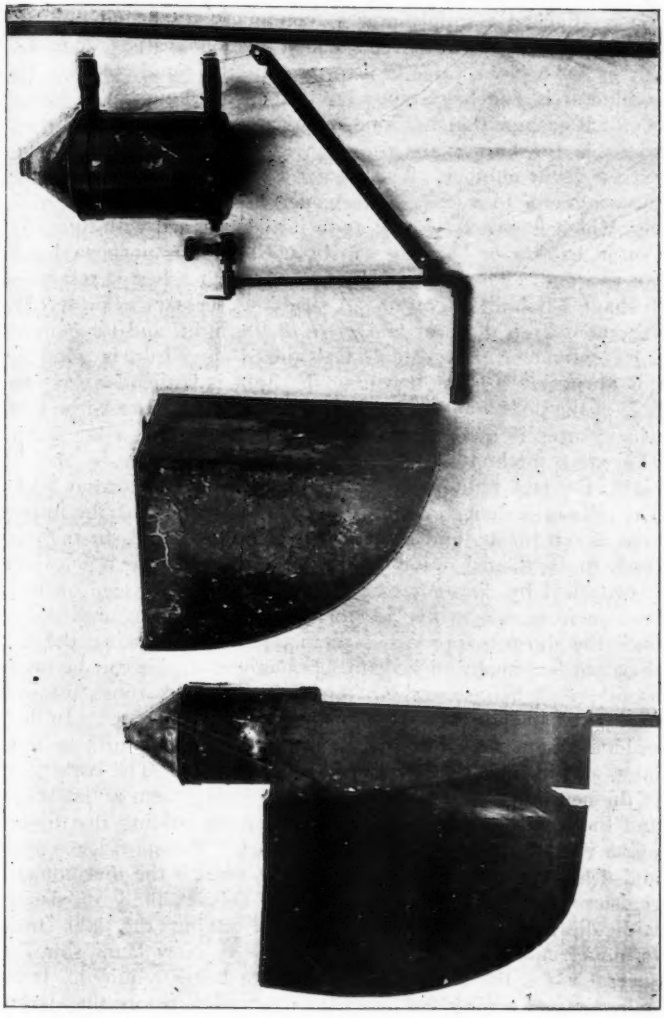
here that wild trout should not be disturbed in confinement any more than is absolutely necessary. Between 400 and 500 fish were retained at a time, one crate always being kept empty for use in transferring unripe fish.

Methods of Capture.—The implements used in the capture of lake spawners consist of spacious but easy-running boats, tooth-nets, dip-nets and jack-lights. I erroneously designate as "tooth"-nets, gill-nets of a mesh too small to gill the fish.

The above described station was equipped with one each 100-foot and 200-foot gill-nets of $1\frac{3}{4}$-inch mesh ($\frac{7}{8}$-inch knot to knot) and 6 feet deep, colored blue. Fishing was conducted day and night, or when the weather was favorable, lee shores being selected if the wind blew, it being necessary to have the water calm enough so that the fish could be seen upon their beds. The dip-nets resemble large landing nets, the hoop or net frame being 15 to 20 inches in diameter, made of $\frac{1}{8}$-inch gaspipe and the net being 2 feet deep, of as coarse a mesh as the size of fish to be dipped will permit without gilling them. It should be of rather fine thread and barked or colored blue. The latter color is best for work at night. After a fisherman has had experience with dip-nets, he will have his own ideas about the style of net, dimensions, etc.; but the general description given above will hold good with all. The technical description of a dip-net for ordering from the manufacturers is as follows: "52 meshes round, 28 inches long, $1\frac{3}{4}$-inch mesh; 16-6 cable, barked, with twine strung through the top 5 feet long."

I have tried several forms of dip-net frames and finally settled upon the $\frac{1}{8}$-inch gaspipe as the best for lightness, strength and durability combined with cheapness. A better but more expensive net frame can be made by the same method that pitchforks are made, only continuing the process by drawing the tines of the fork around until they complete the arc of a circle. This form of net frame has the advantage of being strong, light and more slender than the gaspipe for rapid work under the water. The handles of the dip-nets should be of light and strong material, and I have found nothing equal to the bamboo for them, using 8 or 10 feet from the butts of fishing poles.

The jack-lights are an important feature of this work, the larger part of which is done at night. I have tried reflecting lanterns of many kinds, but have found nothing equal to the light constructed as per accompanying photograph. It consists of a gallon can fastened to a gaspipe standard, so that it can be raised



JACK LIGHT FOR DIPPING WILD TROUT FROM THEIR SPAWNING BEDS IN LAKES AND PONDS.

or lowered, also revolved in the arc of a quarter circle. To this can is attached a supply pipe to conduct kerosene oil from the can to a perforated burner suspended over the water. This conductor has a globe valve in it to regulate the supply of oil. The conductor is ¼-inch gaspipe about 12 inches long. The burner is ½-inch gaspipe 6 inches long, with cap at the end. The perforations in the burner are 1-32-inch in diameter, and should not exceed 20 in number. The burner is made of larger pipe than the conductor to it, as a convenience in winding asbestos wicking, which is loosely wound upon it and fastened with fine wire. Cotton batting or bagging can be used for this purpose, but is not as good. The burner when wound with asbestos resembles in shape a bobbin of cotton. A shade is necessary to protect the fishermen from the heat and glare of the light, and for convenience should be detachable. Galvanized sheet-iron is good for this purpose. For night fishing the light is suspended over the bow of the boat, the standard being screwed into a cast-iron foot, which latter is attached to the boat by means of a lag screw. The same method of fishing is employed whether by day or night, the jack-light being the only additional feature at night. The gill-net is then thrown around the spawning bed, the fishing boat is run inside, and a man with a dip-net stands in the bow ready to dip the fish. He directs the guidance of the boat, which is propelled by one oarsman. The fish are easily seen on their beds in from one to five feet of water, and remain undisturbed until the dip-net approaches them. If they lie facing the net, they can be usually picked up. Sometimes a pair can be taken together. When several are on the same bed, those that are frightened away invariably start directly for deep water. In their sudden plunge they run against the gill-net, are caught by their jaws, and in their struggles wind up in the net. The cork floats of the net are painted white to facilitate seeing them at this stage, and the fish thus caught is easily taken by holding the dip-net under it and then shaking out the gill-net. The sport is exciting, and fishermen forget the time of night, even if the thermometer registers far below freezing point. This method of fishing with dip-nets was first employed in taking the lake trout (s. namaycush), and has been in vogue in New Hampshire for several years, the use of the gill-net not being required. It required much urging and practical illustration before the spawntakers would believe that brook trout could be dipped up in the same manner. As fast as dipped up, the fish are put into tanks of water and kept in the boat until forty or fifty trout are cap-

tured. Common sugar barrels will do for tanks. Seines can be used to advantage if the spawning grounds are smooth enough; but the majority of them are not. It has been my experience that the dipping process is less expensive than seining even on smooth grounds. The fish run best the first part of the night, and night fishing is conducted from dark until midnight. The spawning season of brook trout in lakes varies the same as it does with those spawning in streams, and is apparently affected by the height of the water. The first fish captured in the lake last season were taken October 29, 1896. The last ones were taken December 2, after which time the lake was frozen over. The trout could be seen at work on the beds long after the ice closed over the lake, and, in fact, until after January 1, 1897.

The total number of trout taken with dip-nets was 1,457; average weight of each fish a little over a pound. The number of males exceeded the number of females in the proportion of two to one. This has been the experience in the work of three seasons. The first stripping occurred November 6 and the last December 11. Total number of females stripped, 362; total take of eggs, about 500,000. The eggs were eyed in a shanty fed by springs near the lake, three troughs of trays in stacks being used for the purpose. As a matter of information, twenty-nine female trout, stripped of spawn at this field station November 26, 1896, were measured and weighed and the number of eggs yielded by each recorded. The girth, as given in the following table, was taken before the trout were stripped and with a scale which might not be regarded as entirely accurate, but approximately so. Some of these trout had apparently dropped part of their eggs before being captured.

Length in inches.	Girth in inches.	Weight lbs.	oz.	No. of Eggs.
13	7	1		1,394
18	7½	2	6	2,665
10	7½		6½	492
11½	6½		8	615
17	11	2	1	2,563
17½	11	1	14½	2,358
8½	4		3	130
12½	7¼		11½	1,312
12½	7		10	820
11½	6¼		8	410
11½	6		8	615

10½	5½	6½	308
12	7	9½	820
16½	9	1 10½	923
11	6	8	615
13	6¾	11½	1,025
17	10	2 1	2,665
13	6½	11½	923
11½	6¼	11½	820
12	6	10	718
16	9½	1 9	1,845
10	5¾	6¼	656
16	10	1 14½	1,948
16¾	10½	1 12	2,563
14½	8	1 2½	1,845
13¾	7¾	14	1,074
16	8¾	1 8	1,845
17	10¼	2	2,665
15	9¾	1 8	1,948
Total for 29 trout,		31 6¾	38,580

The average weight of fish taken throughout the season will exceed that deduced from the above table, the males averaging in weight much more than the females. There is a very marked difference in the size of eggs of brook trout taken from different waters, and the size of the eggs does not depend upon the size of the fish. The variations in size of eggs taken at three field stations last season were in the proportions of 34, 41 and 42 to the square inch respectively. The eggs numbering 34 and 42 to the square inch were taken from fish averaging five to the pound, while the eggs 41 to the square inch were taken from trout averaging over a pound each.

I will not discuss the subject now, but I believe that after successful field stations like those I operate have become permanently established, it will be advantageous to study the conditions surrounding the spawning grounds of each and see if the eggs do not require different conditions of water supply in artificial work such as volume of water to each trough, etc., to produce the best results.

Utility—In the collection of brook trout, the writer has always borne in mind that eggs can be purchased at very low prices, after they have been brought to the eyed stage; in fact, it is difficult to attempt to compete with the commercial fish culturist in

the cost of wild trout eggs laid down in the hatchery as eyed eggs, because the cost of eggs thus collected should not exceed the cost of eggs of the domesticated trout, either being figured as eyed ova laid down in troughs where they are to be hatched; otherwise it would be expedient to buy eggs already eyed. There are some advantages about having the eggs of wild trout. The latter, if in suitable waters, would naturally be stronger fish than the inbred fish of the commercial hatchery. In answer to this argument, the commercial fish culturist will tell you that he frequently makes exchanges of eggs and fish and uses many precautions to keep up his stock of hardy fish. As a rule, the eggs of domesticated trout will eye and hatch a larger percentage than wild trout. Much depends, however, upon the facilities for taking the eggs of the latter, which means, also, the methods of taking the fish and retaining them until stripped. The lowest price I have been quoted by commercial fish culturists for eyed ova of brook trout is $0.70 per M. in lots of a million or more. To this price must be added expressage on the eggs to hatchery where they are to be propagated. To sum it up in one sentence, the utility of collecting wild trout spawn depends upon whether the cost of eggs thus collected is less than the cost of purchased eggs. Another point to be considered is whether the spawn deposited naturally would yield a large percentage of fry.

I have mentioned a so-called "dry brook" in which the trout congregated in large numbers at one of my stations. One month before these fish ascended it, I personally examined it. It was then apparently a surface drain fed by a slight seapage of water from the muddy soil along its banks, but practically dry. I decided that it would be impossible for trout to ascend it even during rain storms, and still believe that no spawn deposited in it would ever mature. I have visited several ponds where the trout cannot possibly ascend the feeding brooks until high water. When they do succeed in making the ascent, they have no time to prepare their beds, but must return to the lake in from twelve to twenty-four hours. The results from eggs naturally deposited in such places is practically valueless. In the case of lake spawners, the same spawning grounds where I operated were being cleaned by later spawning trout for a month after I discontinued my collections. The eggs of the fish I took, if deposited naturally, would have been eaten by the later comers or by the suckers and minnows which follow after them.

Many private clubs have well stocked ponds and a man to look after them, and yet purchase eggs for restocking. The

utility of saving the spawn going to waste in such places needs no further argument. The cost of wild trout eggs will vary as a matter of course, and I have not found suitable or what I call paying stations without trying several which were afterwards abandoned. I have not written this article to encourage competition with the commercial trout culturist, but to encourage a larger production of trout with the means available in State commissions or private preserves. I am unable to say whether the collections made in this way are less expensive than carrying a stock of brood fish as in vogue at State hatcheries and institutions of a similar character, but this method can be used to advantage as an auxiliary to such institutions.

DISCUSSION.

Mr. Bryant: I would like to ask you in respect to one topic you touched upon there: What is your observation, if you have any, as to the difference between planted fish where the spawn is taken by your method from the wild fish, and the other and older form of spawning domesticated fish? Have your observations extended so far as to know the nature of these fish when they grow up? For instance, taking the fry from the fish fed artificially, they become deteriorated probably from confinement, possibly from in-breeding. When you distribute the fry you take from wild fish, do you find them in a lively condition when they grow up to maturity in the wild state? Is there any difference between those fish and those taken from domesticated fish?

Mr. Titcomb: I am not prepared to say. Fry of wild fish, as you are aware, are fed like other fry and they take food like the fry from the domesticated fish.

Mr. Bryant: In our ponds we had 55,800 trout on the first day of April, and most of them were born in the ponds. I would like to get some information as to the character of the offspring of that class of fish when they grow to maturity, having been planted in good natural water. Mr. Clark is probably able to give some information on that point.

Mr. Clark: Your question, as I understand, is: what the difference is, if any, after they are planted. I do not know as I understand your question.

Mr. Bryant: After they are planted and grown.

Mr. Clark: That is hard to tell. Unless some stream has been stocked with fry taken from wild fish and another stream

stocked with fry from domesticated fish. As I understand this matter, there has not been time enough since they began to get the wild eggs to know. Mr. Titcomb has taken them three seasons.

I took eggs on the Au Sable river last fall from wild fish and the methods I pursued were somewhat different from Mr. Titcomb's. I got something less than half a million eggs, 400 and some odd thousand, and the fry from those eggs were vigorous, more so than fry from our domesticated trout, but those we reared in the pond after six months or so of feeding you could not tell from the others. Now, the planting of those back in the streams and the results afterwards, I do not know. Of course, we put one hundred thousand we got from the Au Sable right back into the Au Sable.

Mr. Bryant: I can see how in-breeding might deteriorate them. It might tend to reduce their fecundity, they are hardly as vigorous. When they get grown up in wild waters, are they as vigorous as those "to the manner born"?

Mr. Clark: As your domestic fish breed in and in, necessarily the percentage of impregnation must be lower, is that the idea?

Mr. Bryant: Yes, sir.

Mr. Clark: I do not know whether that is so or not. It is not so according to our experience.

Mr. Titcomb's 97 per cent. was a startler to me. Our experience with wild trout eggs was not anything like that. I did not suppose it was possible to get as good impregnation from wild trout as from domesticated fish.

Mr. Titcomb: Ninety-seven per cent. of impregnation was got from the trout from that one lake only, but we had a most perfect water supply. At the station where we took eggs in the trap we only got 27 per cent. of impregnation. I did not mention that in the paper, because I did not attribute it to any lack of the failure of the principle, but to a lack of something in the operations.

Mr. Clark: We tried several experiments on the Au Sable by different spawn-takers, and have tried every conceivable way, and we could not begin to get any such percentage.

Mr. Dale: What did you get?

Mr. Clark: An average of about 70 per cent. and I attributed it to the fact that they were wild fish.

Mr. Bryant: How far did you transport them?

Mr. Clark: We had a temporary hatchery right there The best water and the finest water I ever saw, and our troughs were set right up over the stream. The eggs were put on gravel. All our green brook trout eggs are put on gravel when they are first taken, and I pursued the same plan there.

Mr. Titcomb: We put our eggs five thousand to the tray and about ten trays deep.

Mr. Clark: That is my plan for brook trout when first taken, and has been for a good many years. Right on this subject, there is another thing I would like to speak of and that is the different methods of catching wild brook trout. On the Au Sable River we got the fish from the beds with a seine. In the first place, I undertook to sweep the river. I cleaned the ground for hauling a 150-foot seine, but with that we did not succeed in getting many fish; but with a small 20-foot seine, by going on the beds and having a man above and a man below to keep them from running up and down, and two men with the seine to dip up the fish, we got from 5 to 132 at a haul. We got as high as twelve or fourteen hundred fish in three or four hours. Of course, part of them were culled out. We got altogether between five and six thousand fish in that manner. But I do not think your trap that you described, if I understood it, would operate successfully on the Au Sable River at all. It is too large a body of water and has too rapid a flow. That can be done successfully with the dip-net, by operating it just at the spawning time

On the Au Sable River, I found, instead of pairs making beds, there were hundreds of trout on a large bed. They sometimes have a place cleaned up as large as this room where it will be all perfectly clean and in such a place as that I would sweep the seine, and caught as high as 132 in one haul and a good many of them got away from us.

Another point Mr. Titcomb brought out was the fact that these trout run up this trout stream, from being disturbed, to other places. That was not our experience at all. Our experience, with marked fish, was that they would go right back on to that same spawning ground and be caught again. We took fish from this bed and took them to our camp half or three-quarters

of a mile below, and stripped them. Of course we turned all our fish back into the river, marked some, and we would catch the fish right on the very same bed—the marked fish. We marked the fish with a tin tag and caught them over again.

Mr. Titcomb: I did not mean to be understood that the fish had taken the cue from the fact that we had caught them from one brook and then gone into another. I left that as an open question, and I still leave it as an open question, and I am glad to hear Mr. Clark's ideas on this subject. With the lake fish, that was our method of fishing. We took once 140 fish at a haul, but I found after a while that that method was not practical, as there was only one bed in the lake where we could use that method. Our boats in the lake require a 200-foot clear sweep in order to swing around the whole bed Sometimes there would be six fish in a circular nest, but ordinarily we would strike two fish together—that is, they would run together.

I want to say another word about that trap. The streams of Vermont, where the brook trout are now found, are mostly small streams, ten to fifteen feet wide, and it is hard to build a trap in a small stream. The trout all run in that small entrance. The most of our waters are trout waters. Some of them have been spoiled by putting in pickerel and other coarse varieties of fish, and the nature of some of our streams is being changed so that we cannot hope to restore trout fishing in them. We get some good results from stocking our trout ponds. These mill ponds I described are simply ordinary trout streams, four by six feet in width, dammed up simply for the purpose of floating logs, and it was several years before they discovered they had such a wonderful trout pond, and it was one of the most prolific natural breeding places I have ever known. The trout had originally the forest stream to breed in, and had no falls or any great rapids in the brook, and it was fed by little bits of springs running into it.

Mr. Bower: I want to say that Mr. Titcomb is certainly very fortunate, more fortunate than we are in Michigan in having these places to get the wild trout from. With the exception of the Au Sable River, and perhaps two or three other streams, we are not favored as you are in Vermont. We have no lakes stocked with brook trout from which the fish run into the streams.

The method employed by Mr. Titcomb in catching the trout is substantially the same as we used at Green Lake Station, where

I was stationed for some months, and while it worked very successfully, there was great annoyance in connection with the catching of the fish that I don't think you referred to—if you did, I did not hear you—and that is the streams running down through dense woods along about the time of the year when the fish were spawning, were covered with immense quantities of leaves, and we had continuous trouble to keep the rack free, and sometimes there were periods when two men would be kept constantly busy at the screens, and it occurred to me to ask you you managed to obviate that difficulty, if you experienced it.

Mr. Titcomb: I did not carry that point far enough in my paper, Mr. President I spoke of having a shanty and bunk, where a man could sleep. He was isolated in the woods, and at the end of sixty-six days he wrote for leave of absence to go home and visit his family. He kept a rake there and raked off those leaves, and one night he took 1,600 trout in that trap, and he was dipping as fast as he could dip. He was an old fisherman, one of those old hardy fishermen that always know where the big trout are in a stream. He was out there alone, and he wrote me a long letter, stating how the stream came up, and he woke up in the night and the water was flowing all around his shanty, and he didn't know whether to stay or run, and then he found if he ran he had to wade through a stream up to his waist, and he stayed and dipped until midnight.

Mr. Bower: That was on account of the leaves?

Mr. Titcomb: No, sir, that was on account of the pressure. The water was high. The weir takes up four-fifths of the brook, and the opening is not sufficient in case of such a rise. That trap method I did not pretend to originate at all. It is simply a method of fish culture which it seemed to me had not been written up, and I wrote it up for that purpose. The method of dipping them off the beds is one which I originated; I may not have originated it, of course the Indians used to dip in olden times, but for my work it was original with me.

Mr. Bryant: Those traps were first used in Maine by Mr. Atkins.

Mr. Titcomb: Yes, I corresponded with him about it.

Mr. Dickerson: Are all your lakes stocked with brook trout? Do they grow in all your lakes?

Mr. Titcomb: The lakes in the natural state, before the destruction of the forests, were all trout lakes. The Connecticut river was a salmon stream and carried the salmon up to all the smaller streams in Vermont. At that time there were salmon and trout. Of course, the salmon have all gone, and the lakes back in Vermont in which the trout have not been destroyed by the introduction of pickerel and that class of fish, are natural trout waters, with the exception of some lakes, where the surroundings have been entirely changed by the demolition of the forests, so that the temperature of the water has raised. While this method of fishing does not apply to your State here and your vicinity, it would apply, I suppose, in a State like New York, where they have lakes abounding in trout, and the same in the State of Maine.

Mr. Dickerson: I know some of the lakes in Maine have trout in them, and many of the lakes in Canada.

Mr. Nevin: I have tried to set a trap after the manner described, but the leaves would get in there enough to clog the trap and we could not keep it clean at all, then we used a fyke-net and drove the fish into it.

Mr. Titcomb: Didn't the pressure of the water collapse the fyke-net?

Mr. Nevin: No.

Mr. Titcomb: The fish would try to go over the top of the weir in the pond I speak of; in this trap, the trout would go up to the weir before the trap was built and you could stand there and see those trout jump up.

The Chair: We will now listen to a report of the Committee on Nominations.

Mr. Peabody: The Committee on Nominations unanimously report for officers for the coming year: President, W. L. May, of Nebraska; Vice-President, G. F. Peabody, of Vermont; Recording Secretary, Herschel Whitaker, Detroit; Corresponding Secretary, J. E. Gunckel, of Ohio; Treasurer, L. D. Huntington, of New York. Executive Committee—James A. Dale, of Pennsylvania; E. E. Bryant, of Wisconsin; A. N. Cheney, of New York; J. W. Titcomb, of Vermont; J. L. Preston, of Michigan; F. N. Clark, of the United States Fish Commission, and H. A. Sherwin, of Ohio.

On motion the report was unanimously accepted and adopted, and the nominees were declared elected.

The Chair: I want to say in behalf of one man on that list of officers, I think the name was meant for Whitaker, although it was not read so, that if that is the name, I am prepared to serve this society in any capacity they see fit to ask me to serve them. Of course, the office of Secretary means considerable work, and I will take it with the understanding that I have the co-operation of all the members present, in order that the report may be gotten out in a fairly reasonable time. The proof will be submitted to gentlemen as promptly as it can be got out by the printer. I shall wait for you ten days and if after that time I hear no response, I shall wait no longer, because the report had better come out in the shape it is than to be left over seven or eight or nine months. So you can be prepared to take your chances if you do not reply in ten days.

Prof. Birge: I have just had handed to me this morning's Chicago paper in which it is stated that the Natural History Building at Champaign, Ill., was struck by lightning and damaged ten thousand dollars and the collections, chiefly those of Professor Forbes have been damaged, to an estimated loss of $50,000. I move you that the Secretary be directed to telegraph expressing our sympathy with Professor Forbes and the loss science has sustained during this accident.

The motion was seconded and unanimously carried.

Chair: We will now listen to a paper entitled "Advancement in Fish Production," by Mr. W. D. Tomlin, of Duluth.

ADVANCEMENT IN FISH PRODUCTION.

By W. D. TOMLIN, of Duluth.

To secure the best results with the least expenditure of mental or physical forces, time and money are the requirements of the age we live in. In the summing up of the qualities that make the so-called benefactors of the human race, the ability to distribute wealth, though commendable, does not carry away the palm. The man who by a series of experiments, succeeds in producing results that increases the sum totals of natures implanting a hundred fold, is well along the road to produce a benefactor —if by increasing food supplies, creature comforts, or devising recreation as a means to relieve over-worked humanity is just as much a benefactor as he whom from his abundance, relieves the distress of his fellow creatures.

So, he who in the realm of nature, by careful cultivation produces an increase far beyond that which would be developed by nature's prolific handiwork, must in the same sense be considered as a benefactor—especially when by such means the comforts or well-being of large masses of the commonwealth are added thereto—and if by such means the masses can enjoy what has hitherto been a luxury, these benefactions are increased a thousand fold.

In such a gathering as this, where men whose minds are trained to expect large results, whose work is for the future, who are building for the future; men gathered from the toiling east with its busy hum of industry, men from the brawny west and its grain producing prairies and the land of the setting sun, meeting to confer on the middle grounds of the states bordering on these great waterways; where the busy toilers whose perspiring forms shape and fashion into elegance these monsters of iron that are building up the great empire of the west, these bringing the products of the busy looms of the teeming east and carry them westward, where meeting the produce of the prairies and the mountains and forests, at the docks and elevators of the unsalted seas, bringing back grain, wool, flour, lumber, iron, copper, silver and nickel; and here where the very air is resonant with the song "Iron is King," and the iron and steel age assert their supremacy; under such shadows we unite to consider the produc-

tion of such food that shall form a part of the daily sustenance of the millions of these surrounding states.

It is on these great waterways, that produce such abundance of fish food, especially of such delectable and enticing flavor, that even the convalescent longs again for the repetition of the dainty dish. In these waters the "Namaycush" and "Coregonus" have their habitat; in the depths of these cold waters nothing putrescent contaminates—400 feet deep and 33 degrees to 39 degrees Fah'—conduces to a purity phenominal.

The advance in the practice of fish culture has become so popular, that even the toilers on these waters recognize in these fish hatching stations and their keen sighted employees, possibilities that are advancing the interests of even fishermen, and means to them more than a subsistence. From these men used to handling fish there has come scores of times the oft-expressed wish to understand thoroughly the best ways to increase the supplies of food fishes they handle; even the legislative committees at the last session were asked to consider some means whereby fish should be secured to supply the places of those taken by nets in international and boundary waters. Fishermen are said to be sordid, seeking only the present good; yet theirs is the desire to increase a knowledge of the taking of spawn that will produce the very best results; and tens of thousands would accrue, where now but hundreds are produced by the methods they employ

As to the fitness of such workers, there can be no question, inured to cold and exposure, hardy toilers, indefatigable, persistent even to face fearful odds—absolutely proof against that bane of all landsmen,"sea sickness," they will still face every danger, even though beaten back by winds and storms.

There are no more amusing sights than to see a man trying to strip a vigorous squirming fish, at a time when an irresistible impulse comes o'er the individual to balance his accounts by "feeding the fishes."

I have known such fishermen in the excitement of a rush, when a net full of ripe fish were secured, wade in almost waist deep into waters positively chilling; and in their eagerness to take all the eggs that were possible to secure, to lift their hats and wipe away the drops of perspiration from across the forehead.

A gentleman quite prominent as a successful culturist in his work said, but a few years since: "I would rather have a good fishermen possessed of good horse sense, and let him get into

a net of fish that we wanted to strip from, than any landsman I could ever train; they will endure harder work without fatigue, do not suffer, and once get them interested will strip with more intelligence and care than any man I could ever train; they make the boss strippers; no man can successfully strip a large trout when his teeth are chattering, and his entire body chill and numbed with cold."

An employee of a hatching station who has secured millions of eggs has said: "I always prefer a fisherman for the work, where they take pride in it as some do; they have always secured more eggs than I could myself, because of their rugged physique and physical endurance. I have had the best results from eggs thus stripped by men who have followed the fishing business for years, and know that some of them have stripped eggs from the Lake trout for the past ten years, when ripe fish are found in their nets."

This idea has become engrafted on the minutes of the association I represent, that its sentiments are voiced in suggestions to the legislature recommending, "That every steam vessel or tug engaged in fishing with nets should have provided a bucket that should be kept ready for use, and for this purpose alone; so that when lake trout are caught when ripe, and the eggs are exuding from the vent, that such fish should be stripped, and that such stripped eggs should be milted with the first ripe fish caught, and the bucket then set aside in a safe place to allow the eggs to become fertilized.

To better insure such fertilization without possibility of endangering the eggs by the introduction of deletrious matter, a piece of rope made like a swab (like sample furnished) was wetted and soaked, then used to stir the eggs, thus permitting the thorough circulation of the fluid amongst the eggs without putting dirty hands into the bucket.

This has been done for years, and singular though the process may be, yet the eggs deposited in the grounds the fishermen knew of, have produced the very cream of lake trout in the last few years; these fishermen are not so egotistical as to assert that this is the best way to secure the production of fry, but they do claim that even twenty per cent. gained is better than to throw all the ripening eggs into the water, and thus destroy all possibilities of a return of nature's provisions; the experiment has proved worth a trial. Even the busiest of the men would watch with interest the changing color of the eggs, the firmness and stiffening of the eggs after the thorough commingling of the life-giving proper-

ties, and when the mass was quietly slid into the water the comments were: "There goes another batch that will come back to us or some of us within two or three years."

If such work can be done by men in such a hurried manner, and by slippery fingers without being trained, and will produce the results described so that fishing has kept good on these grounds for fifteen years, and has been up to its standard of former years, what results would be accomplished if fishermen were instructed by men appointed for that work, and the mass of fishermen intelligently instructed and encouraged to assist the state or national government in this great work.

The idea has grown into circulation that fishermen have no thought beyond the present moment and would not use such methods after they had been trained for effective service.

Has it ever been tried?

Again; in all the Fish Commissions of the states surrounding these great lakes has ever a member of the fishing fraternity been appointed to the office of fish commissioner?

Has any attempt been made to secure laws that are practical in their working so that the laws could be obeyed?

Have means been tried to secure a better interest in the laws made to protect fish by securing a united action of fishermen for the support of such laws?

Contra; the men who are supposed to enforce the laws—the Game and Fish Wardens—have made the fishermen the spoils on which to recoup them for their work; seizures have been made by men having a show of authority; and though the injustice of the charges have been proven, yet no satisfaction was given as to freedom from such legalized robbery; men have been threatened with arrest, their fish seized and sold; the men told to quit fishing, just because a pompous individual desired to air his little authority.

Such treatment does not conduce to any love for a fish commission nor its officers.

If any desire was shown to consider the costs of such an experiment as herein described could not a sum of money be spared from the commission work of these states, or an allowance made from the funds of the United States Fish Commission.

The experiment tried one season would settle the question and all the men would readily "catch on," and on the waters of these great lakes lakes there would come an army of strippers that would render to the Superintendents of the Fish Hatching stations valuable service at any time when needed.

From an experience of years of acquaintance I am in possession of data that has never been secured, but from the fishermen always freely given. Since the Duluth Hatching station has been doing good work, the fisherman's interest has been aroused, and when anything of especial interest occurs their secretary is put into communication; when any large catches of whitefish, lake trout, blue fin or long jaw occur, reports come in. Last fall a short message came to me: "A splendid run of whitefish had been seen in Siskowit Bay on the Wisconsin shore, the first seen in years, and they had spawn in them." It was too late at that time to report because the season was advanced and navigation was closing; from Isle Royale there came a report from one of the most reliable and intelligent of our fishermen: "A large school of whitefish are working on the reef at Fish Island; there are thousands of them and were there some days, and are spawning." The water is so clear on this island that the movements of fish can be watched at depths from fifty to sixty feet.

Arrangements are being made to report such matters as these so that the Hatching station can secure eggs if they so desire, but when fish commission employes go to a point when fish are spawning, and plays sick because the waters are a trifle rough and he suffers from an attack of qualmishness, and then returns and reports that he could get no eggs because there were no ripe fish, fishermen quickly estimate the cost of such incompetence.

(I am in a position to know that several boxes of spawn were secured by fishermen, while the expert was laying under the brush hugging a whisky bottle.)

If the question of expense is to be considered, and the percentage of profit or loss, suppose we look at the possible water areas that should be cultivated. It has been often quoted in past years in the commission reports of different states that in some portions of the world that an acre of water is made to produce as much wealth in fish food as an acre of cultivated land produces.

In the chain of great lakes backed by the falls of Niagara there are 62,500,000 of acres of water. Suppose we adopt this formula, it would read:

Area, multiplied by acres, multiplied by products, multiplied would equal and read A×ac×pro =$748,000,000.

The three lakes producing the finest of whitefish estimated by this formula would read:

Lake Superior Area×ac×pro' would equal.....$239,000,000
Lake Michigan Area×ac×pro' would equal.....$153,940,000
Lake Huron Area×ac×pro' would equal.....$132,000,000

These figures are given in round numbers, and are based on the repeated calculations of cultivation of water areas where water is made to produce wealth.

Let us suppose that the estimated consumption of fresh fish is 150,000,000 pounds annually, and that there are imported into the United States 100,000,000 pounds annually. The estimated value of these commodities would be $7,500,000. What a small percentage of profit in comparison to the possible opportunities for food production; a comparison between about $750,000,000 and $7,500,000.

To supply an existing deficiency of ten years ago the United States Commission expended on building and apparatus on these lakes $62,000.

Its operating expenses are.....		$20,000 annually
It is possible that the states have expended	$50,000	$30,000 annually
This is equivalent to an expenditure of	$112,000	$50,000 annually

to secure a money value of about $7,500,000.

If we compare these values of the water products with the water products in countries whose food is largely fish and where fish are cultivated the result would be a comparison of $750,000,000 to less than $8,000,000.

If the 150,000,000 pounds of fresh fish taken in American waters are valued in the ratios of fish value of other products the ratio would be $4,500,000.

Suppose we estimate these fish values, numerically 75,000,000 of fish, and if it was possible to instruct men and interest them to do the spawning as suggested, and if 30,000,000 of fish could be thus spawned, would not a possible 250,000,000 fish be a fair percentage for the experiment?

These figures may seem optimistic and far-reaching, but they are within the limits of computation and certainly when we know the vast areas of these unsalted seas and the possibilities of their production they cannot be thought visionary.

It has been well said: "*Through the Niagara river speeds the overflow of the four upper lakes, where the majestic St. Lawrence carries it off to the ocean. The shores of eight of the United States and two of the vast provinces of Canada are

washed by these waters. A large fleet plies between these harbors, carrying greater riches of food and minerals than any other lakes or seas in the world. Nature has lavished her most beautiful scenery on some of the shores and manifests herself in the famous water-falls in her most imposing grandeur. Lake Superior is a little larger than Lake Victoria Nyanza, and is therefore the largest fresh water lake in the world.

Mr. Vodel, of the Western Society of Engineers, has well said: "That the catchment basins of about one-half the globe center in the territory of these great lakes and the half of these areas are fresh pure water, the purest in the world." We are obliged to admit these facts; then if admitted, what are the possibilities for fish production? Illimitable!

For every dollar invested, either by the national government or the state commissions, there are probabilities of large returns; and when in the coming years these fish commissions shall extend a hand to assist the men to whom of all others comes a knowledge of the resorts of these deep water fishes, the spawning grounds, the feeding grounds; the very nature of the food laying along the reefs on which these fish feed, and whose daily avocation brings to their eyes the bottoms of these lakes, from these men information valuable to those engaged in producing the millions of fish fry to be returned to these waters, will be readily secured and assistance extended.

Let the state commissions, or the United States commissions, accord to these men the courtesy that belongs to manhood, the respectful consideration one man owes to another, a recognition of right and justice; let a showing of sympathy be extended to them instead of all law; let some encouragement be shown by an appeal to that side of humanity that melts under the genial sunshines of a brotherhood of common interests, and these fish commissions will have no more effective assistants nor earnest helpers than these same fishermen.

Give them laws under which all men can live, and they will respect and obey law, and if a few hundred of dollars are expended in effective education in the manner suggested; then along these lake lines will come a body of men, who from their crude instrumentalities yet dogged perseverence will assist to restock these lakes with the very fish that should prove a greater inducement to intelligent fishing, and a mine of wealth richer by far than the glittering quartz along the boundary line of Minnesota, and perpetuate a fish that serves as the daintiest tid-bit that

ever a convalescent coaxed back a capricious appetite, that most famous of all dishes a Planked Whitefish.

Mr. Clark: I want to refer one point in that paper. He spoke of some five hundred thousand or a million dollars being expended by the United States which I think is too much. Won't you please refer to your figures again, Mr. Tomlin?

Mr. Tomlin: "To apply to the existing deficiency the United States Commission has expended $62,000—"

Mr. Clark: Have you got your figures authoritatively?

Mr. Tomlin: I got them from Commissioner Brice.

Mr. Bower: I was in Duluth and had charge of the putting up of that hatchery. The contract for the building, I don't remember exactly what it was, but it was between $10,000 and $11,000. That is all that was expended at that point.

Mr. Tomlin: That is on Duluth alone. I said the Great Lakes.

Mr. Stranahan: There must be some mistake somewhere You take Alpena and Duluth and that is all there is substantially. There is a station on Lake Ontario, however.

Mr. Bower: Mr. Tomlin has drawn an entirely wrong conclusion from the figures I used. I do not claim because we hatch five hundred to a thousand times as many fish as nature does from the same number of eggs that we are going to get from five hundred to a thousand times as many adults from them. There is, of course, an immense waste. I think Prof. Reighard showed this morning that it would be absolutely impossible for the waters of these lakes to support such an amount of fish. They would mostly starve to death. It is fair to presume that a hundred years ago, before fishing was commenced in the Great Lakes, they held all that the waters could possibly support and the numbers of whitefish then in the lakes or of the lake trout or other valuable species was certainly below the number Mr. Tomlin mentions.

Mr. Dickerson: I would like to ask Mr. Tomlin how the commission can do injustice to the commercial fishermen by seizing their nets if they are fishing legally? So long as the commercial fishermen are respecting the laws of their states they are not disturbed.

Mr. Tomlin: That can be explained easily enough. Wisconsin and Michigan had a law that no net should be set within three miles of shore lines—

Mr. Whitaker: You are mistaken about Michigan, as we have no such law.

Mr. Bell: You are mistaken about Wisconsin also.

Mr. Tomlin: In each of these states nets were seized that were within the limits.

Mr. Dickerson: They have in Michigan in two or three cases, seized nets and destroyed them, but in every case there was a violation of the laws of Michigan. The fishermen did not respect the laws of the state. There is no question in my mind that if the commercial fishermen would strip their fish and replant the eggs it would be a help not only to the commissions but it would go a long ways towards helping to maintain our present fisheries and again restock the waters. But I am afraid it would be a hard matter to educate them up to it. In 1885 the whitefish product of Michigan was almost 9,000,000 pounds. That product has decreased at the rate of over 1,000,000 pounds a year until in 1895 it was only a little over 3,000,000 pounds. Now, the commercial fishermen of Michigan have seen their fish slipping away from them and yet they come to the legislature and ask that the State of Michigan pass a law compelling them to do what they know they ought to have done, and in no single case have they stripped a single fish or done anything towards preserving the waters. It seems to me it ought to be to the interest of the commercial fishermen to do everything that we have recommended.

Another thing, if we have a close season during the spawning season, such a thing as that would not be necessary. We have just passed a law in Michigan making a close season. The fish now will strip themselves and if the commercial fishermen in all the states bordering upon the Great Lakes would help to enact a law protecting the fish during the time of their spawning, nature will then do what you ask the fishermen to do because the fish will lay their own eggs instead of being stripped. I can see readily what a great benefit it would be if what you suggest was performed but when men won't do it in their own interests when they have declined repeatedly for a dozen years to do it, I cannot see how under the sun the United States government or the State of Michigan or any Fish Commission can educate them

to do what they know they ought to have been doing for the last twenty years.

Mr. Nevin: I will say for the last eight years we have had laws in relation to the fishermen impregnating the eggs and planting them back on the spawning beds. In the last eight years we have hired men and used on an average three or four hundred dollars a year to put men on tugs to plant them back on the spawning grounds, and we send them blanks for them to fill up and we keep accurate data. The third year after we planted these eggs the fishing showed great results, especially with small trout on these beds, and those fishermen are the greatest friends we have got.

Mr. Dickerson: Have you a close season law in your state?

Mr. Nevin: I don't beleive in a close season. We can accomplish more without, by having the men strip the eggs and plant them back on the spawning grounds.

Mr. Dickerson: Do you find it necessary to train men to do that? Were not these fishermen sufficiently versed in the trick of stripping the fish to do that?

Mr. Nevin: Oh, they can do that, certainly, but they don't do it unless they are compelled to.

Mr. Dickerson: What I speak of is the necessity of passing a law compelling them to the very thing they ought to do to protect their own business.

Mr. Nevin: We have the law now.

Mr. Bower: A little while ago while I was reading my paper, Mr. Nevin made the statement in reply to my statement that I did not think more than one in every five hundred to a thousand eggs were impregnated naturally that I had got it too high; it was not one in a million. Now, if that is so, what is the use of putting them back; why not take them and hatch where they are protected? Then again, you have not got to depend upon the certificates of your fishermen. What do you want to put them back and let them be lost for?

Mr. Nevin: They would not be impregnated naturally.

Mr. Bower: There is a considerable percentage of impregnation naturally.

Mr. Nevin: There is very little among whitefish. In fact, if there was, our lakes would not hold all the fish. We took this

year 190,000,000 of pike eggs from 3,000 and odd fish and just think of it, the number of pike eggs taken from those fish, when you come to figure up the quantity in all the lakes, it would figure up into the hundreds of billions.

Mr. Bower: We can get a larger percentage of fertilization but we know there is no spawning ground of any kind of fish that is not also the feeding ground of some other fish. Now, why let those go to waste in that way?

Mr. Nevin: I agree with you there.

Mr. Bower: If fish are spawned artificially why not go a step further and secure better results by protecting the fertilized ova until hatched? That is the point.

Prof. Birge: There are certain limits to the size of your hatching houses. The cost of hatching and caring for your fish until they are ready to plant is considerable. By the expenditure of a few hundred dollars you can put back an enormous number of impregnated eggs which need not be taken care of.

Mr. Bower: On that point, I will say there has never been a season, certainly not to my knowledge, when all the hatcheries of the great lakes have been filled. They never have been able to fill them all in one season yet.

Mr. Nevin: In relation to Lake Ontario, I know for the last twenty years there have been very few fish taken from the fact they are not there. At the same time we know millions of eggs are laid there every year, the fish lay their eggs there but they don't seem to increase. There has been no fishing there in twenty years.

Mr. Dickerson: They have fished them out in the same way they are fishing out our lakes now. I say a close season is of no benefit.

Mr. Davis: Is it not a fact that in Lake Ontario, as well as in other lakes that the fish have been caught so small; that the majority of fish have been caught out before they have arrived at the age of reproduction?

Mr. Nevin: That is the trouble around all the lakes.

Mr. Tomlin then read extracts from letters he had received from fishermen and gave data which he had obtained from mixing freely with the fishermen, which he thought was obtainable in no other way. He said if we could only induce the fishermen

to impregnate a thousandth part of their catch, it would be a great saving. He expressed great confidence in the work the fishermen were doing.

He said the spawning season usually took two weeks and with half a dozen men with $360 the whole work could be done in a large area.

Mr. Dickerson: It seems to me every fisherman ought to have interest enough to impregnate those eggs and put them back without expense to the state or general government.

Mr. Tomlin: You must remember these fishermen's fingers are all thumbs. It is a graphic expression but I almost split my sides laughing to see them handle the fish while they were spawning and one big fellow, taller than myself, was in the waist of the boat at one time trying to strip a fish, and the fellow "kicked" him, as he called it, just about the time he was stripping him and he came very near falling over the sides of the boat, and would have done so if I had not been there. The fish went over and his eggs all in its till. So, it is really a difficult matter to get these men to know just what to do. Mr. Wise, of Duluth, has three men working for him all the time.

Mr. Clark: I have been very much interested in this discussion but from my experience, having taken upon the great lakes whitefish and lake trout eggs in large numbers and had a wide experience, probably as long as any of the members, and perhaps a little longer, I do not see where these gentlemen's arguments come in good at all, for this reason: I failed to find a place where ripe fish are caught and put in the boat, where the eggs are not saved. If there are any such spots, if you gentlemen will tell me where they are on the lakes, I will have men there this fall to save the eggs. For four seasons at least we have been short of eggs. We have some difficulty to find places where whitefish were caught that were ripe. All on Lake Huron, Lake Michigan on the east side, and at the Detour there has not been a single spot fished where the United States Fish Commission has not had men in the boats, unless the Michigan Commission or the Wisconsin Commission had engaged the boat. I do not see how there are any whitefish eggs wasted.

Mr. Tomlin has spoken to us about the great number of lake trout eggs that are on the decks of the boats. I want to say it is the same with trout eggs as with whitefish eggs. Two years ago I gave the New York Commission two or three boats that we

had engaged. They could not find places to get enough eggs. Now the waste of eggs from fish that have been caught is not so great as claimed. Of course there is a waste with unripe fish.

Dr. Parker: This interminable fight that comes up almost every session when anything is said about protection has lasted through my whole experience with the commission of some 14 or 15 years. There seems to be antagonism existing between the commercial fishermen and the Commission in some way. It is hardly definite enough to locate, but it is something that ought not to exist. It is just as necessary to catch fish as it is to plant them, and that it what we plant them for. And it seems to me when the commercial fishermen can understand this, there will be nothing really antagonistic between them at all. We had the same fight at Lansing when I was on the Commission and parted worse friends than we were when we met. It seems to me as though some broad form of education might be had of some specific sort—I cannot say legislation for they won't take it—we never have been able to propose any legislation but what hurts somebody somewhere; and so it seems as though if we could take a broad ground and in some way bring about a better understanding it would be better. We all know very well, and especially the fishermen who have the largest interests at stake personally, what is necessary, and it seems to me that we might formulate some broad plan by which the commercial fishermen and this association and kindred associations can bring about some way by which fish can be protected it would be a good thing, if it is possible, if not let us give it up.

Mr. Stranahan: So far as whitefish are concerned, during the seven years I have been at Put-in-Bay the eggs lost have amounted to practically nothing.

Mr. Nevin: In Lake Superior we have been planting fish and I can truthfully say there were more whitefish caught last year than in the last four years put together. We have there the mile limit and last year they were fishing with seines and they caught as high as ten or fifteen barrels of small fish, but of course we nabbed them in time. As long as they catch the small ones we cannot expect to have the big ones.

Mr. Dickerson: That is just what they have been doing in Michigan. We found they had been catching whitefish at Mackinaw that took eight to a pound. The size of the mesh has grown smaller, they have kept getting the mesh down and down

and we have made efforts in the Legislature to correct that. We got together this year at the Legislature and we agreed on a bill. The commission and the commercial fishermen, the pound net fishermen and the gill net fishermen got together in a room of the House and every fisherman present and the Fish Commission represented by Mr. Davis and myself, drafted a bill right there, written by the clerk of that committee, and every fisherman agreed to it and they all went home and agreed to help pass that bill. Within forty-eight hours some of those same fishermen were back there fighting that bill tooth and nail and continued to fight it until the end. We also had a bill in the Legislature regulating the size of the meshes of nets. To show you whether they honestly wanted the bill to pass or not—I am speaking at least of some Michigan fishermen—our bill prescribed the size of mesh of pound nets *as used*, so when you found a man with an illegal sized mesh it was not necessary to go any further to establish the size of the mesh, but they wiped that out and made the bill read as to size of mesh "as manufactured." Under that act, if you catch a man using a two and a half inch mesh and he produces a bill showing he purchased it for a three he is safe. He can have it billed from the factory at three-inch mesh and nothing can be done with him. In order to not violate the law they would order a two and a half inch mesh and have it billed at three inches, and when they were arrested they would go on the stand and swear they bought the legal size, as manufactured, and produce their bill in support of it. Men admitted right before that committee they knew of cases where they had ordered nets at two and a half inches and had them billed at three.

Mr. Whitaker: Michigan undoubtedly typifies to a greater extent to-day the state against which the antagonism of the fishermen has been aroused unjustly, more than any other state in the union. We have constantly, as fish commissioners, brought the product of the hatcheries up to the highest point. We have been putting out into these waters for the last five or eight years something like 150,000,000 to 160,000,000 of live whitefish. We are doing it in the interests of the public, not in the interests of the fishermen. Incidentally the fishermen reap the benefit but the commission inaugurated this work for the benefit of the public and for the preservation of a great food supply. We have been in possession of the causes that are to-day slowly and surely killing the great lake fisheries like a creeping paralysis. We to-day know that that paralysis attacked Lake Ontario thirty

or forty years ago, and we know that that end of the spinal cord has been absolutely paralyzed for the last fifteen years. Fishermen used to say there what they say here, if any interference is attempted "you are ruining our business," and they are permitted to go on in their own way, without any legislation and they are accomplishing their own undoing. Their nets and boats are rotting on the shores of Ontario. Their avocation has passed away never to return, in all probability. What are we of the fish commission confronted with on these great lakes, to begin with, taking the life of the commission as of twenty years of age? With the fact that unlimited fishing has been done from the very earliest time when the season opens and the nets can be set, until it closes by the storms of fall.

As honest fish culturists, we believe we are intrusted with a public duty; that we are not performing that public duty by simply blindly hatching and putting fish in the water. We feel that we must take into consideration the possibilities of the ultimate success of our work. If we propose to go on year after year here and do nothing but plant fish and print the figures in reports, we ought to be bounced out of office. We have a further function to perform. I say to you such work is a misuse of public funds that ought not to be tolerated by any honest community in these United States.

Commencing in 1885, the first and most complete statistics of the great lakes ever taken by anybody were taken by this board. There was then a lapse of five years, when the reports were imperfect. A law was passed that every fisherman should report his catch to the superintendent of the commission in this city. They did not do it. We went to work, beginning with '90, sending out to every fishing station of these lakes a man who has conducted that work ever since, and a man who is absolutely indefatigable in this work, and he gets the statistics and he gets them all. So when we speak of the condition of Michigan's fisheries we are not speculating on what exists in Michigan, but we are talking of what we know to be the fact.

Now, we have gone to the Legislature and said this: Gentlemen, here is the iniquity of this matter. You protect the game, the deer, the birds and everything of that kind, surrounding them with proper protection during the season of reproduction yet the state does not invest a dollar in their propagation. It is a sporting business. But here is a great commercial fishery that with all our persistence we cannot have protected even to prevent the catching of immature fish, to prevent interference with the spawn-

ing fish at the time they are dropping their ova and attempting to perpetuate their kind. We have been met at every turn by the opposition of the fishermen who, if they would take counsel of their own experience, would know they are blocking their own interests. That is what we are after. I say to you now, as has been said here to-day, that the adult fish should be caught for the food of man. They ought to be taken at every season of the year, except at the time of reproduction for that is what they are there for. But our returns show that more than a fourth in weight, not to say anything of number of fish caught in this state, are immature fish that have never come to the spawning age. Add to that the fact that you catch the fish on their spawning bed (that are as well known to fishermen as they are to the whitefish themselves), and you can see they are burning the candle at both ends all the time and the time must speedily come when the fisheries will be ruined. What we stand for in Michigan is the protection of the public interest in the fisheries and their maintenance. Public sentiment has not been aroused but there is a day coming when it will be. I hope not too late. There are many commercial fishermen, however, who sympathize with the idea of protection. But these men are controlled by the large dealers and buyers of fish, who never fish theselves, but who are making money out of the business. The result of it is when a bill is introduced in the Legislature, petitions are sent in signed by Tom, Dick and Harry and when it comes up for consideration in the Legislature the legislator is frightened and afraid that he will antagonize 200 fishermen in his district which may have 50,000 people in it, and he thinks his policical aspirations for the future may be damaged if he antagonizes them.

Let us see what the condition of the fisheries of this state is? In 1885 there were caught 8,143,626 pounds of whitefish. Now, the returns of 1885 did not begin to be as complete as they were in 1891, but that is in favor of the other side of the argument, if anything. In '91 the catch was 8,110,000 pounds. In 1892 the catch was 6,347,535 pounds; in 1893, 5,345,800 pounds; in 1894, 4,496,755 pounds, and in 1895, 3,353,187 pounds, showing a falling off of 5,000,000 pounds. You will observe in looking at this chart, there is not a redeeming feature in it; that it has been a continual decrease, and it is not that feature that I would criticize alone if it showed an increase occasionally. Now they say you are planting whitefish, but they are decreasing and you do not do anything with trout and they are increasing. That is not so, but that is what they say.

The decrease in lake trout has been steadily going on during the same period. In 1891 there were 9,132,770 pounds; in 1892 it was 8,859,000 pounds; in 1893, 8,859,500 pounds; an increase of about a hundred thousand younds that year, less than that a little, but about that. In 1894 it went down to 7,291,295 pounds; in 1895 it went down to 6,293,543 pounds. Now, let us take the quantity of twine fished and see how that increased during the same period. Let us see the devices by which they were captured. If the fish were more plentiful the quantity taken ought to have shown up a little better. Here is a table showing the number of nets in use for the same period. In 1885 there were 25,859 nets of all kinds in this state. In 1891 there were 36,000. (I will leave off the odd figures). In 1892, 38,514; in 1893, 42,075; in 1894, 40,452, a decrease of about 2,000 lbs.

What we say to you is this, as Prof. Reighard said in his paper this morning, it is not as though these fish were evenly distributed over the lakes. They are at one season of the year on feeding grounds and at another period on spawning grounds. These nets are not set evenly over the lakes, and you can comprehend their enormous length when I tell you if they were put end to end they would reach from Detroit to San Francisco and 250 miles into the Pacific Ocean. What chance is there for a single guilty fish to escape? It is all right enough if they would fish with the legal size of net and catch merchantable fish. Nobody would complain. In this connection I would like to read from a letter from a seller of twine, showing how the meshes have been contracted in the last few years. I am not at liberty to disclose his name but he knows what he is talking about; he sold these nets and that is why he knows.

My informant says that the contraction in size of meshes of nets since 1870 or thereabouts, when they were fishing twine in gill-nets of $4\frac{1}{4}$ inches, has diminished as follows: $4\frac{1}{4}$, $4\frac{1}{8}$, 4, $3\frac{7}{8}$, $3\frac{1}{2}$, $3\frac{1}{4}$, $3\frac{1}{8}$, 3, $2\frac{7}{8}$, $2\frac{3}{4}$, $2\frac{5}{8}$, $2\frac{1}{2}$, $2\frac{3}{8}$, until now they are down to $2\frac{1}{4}$ inches.

If the fishermen would come to the front and acknowledge what they know to be the fact, that the fisheries are bound to go unless present methods are changed, if they would extend a hand half way in this work, we could succeed. We were punished by the commercial fishermen this winter, and our appropriation was badly cut simply because we did our duty. I want to say that we will not be deterred from doing our duty, however, because of that. This thing has not significance alone for Michigan. Every state represented here upon the great lakes is

concerned in some degree with the very thing that has been done here, because you are interested in the results of fish planting and what shall be done in the future. What we proposed in the way of legislation was in no way intended as a punishment to anybody, and we have never proposed such a measure. We say the fish are for the public, and the fisherman is the medium through which they should be taken. Nobody objects to the taking of grown fish, but we say they are exercising a privilege and not a right in fishing in the great lakes, and that that privilege should be exercised with a due regard to the maintenance of the fisheries in the public interest. They belong to the people, and it is not a question of fish food for this age alone, but it is a question that affects the generations that follow us, and they will feel the influence of the present waste. Are you, gentlemen, prepared to say that these great channels of navigation shall serve only the purposes of floating ore from Escanaba, lumber from Saginaw, copper from Keewenaw, and the products of the prairies of the great west? Are you willing to simply make these lakes a channel of navigation, or are you going to have these vast waters food producing? Are you going to meekly consent that this may be done without putting up your protest? You know you are engaged in an undertaking that under present conditions can never by any possibility succeed. That is the question that is before us. I say it is an important question. I say no body of men, I care not who they are, can ever deter me from doing what I know is right.

Now let me speak to you as to the attitude of these fishermen. The state, in its wisdom, said we will attempt to stock these waters, and what assistance have they received from the fieshermen? If you go on the spawning grounds for ova you have to pay for the ova you collect, and in addition to that something over. If you go to plant fish they will enjoy the privilege of taking, by pre-emption or some other way, you have got to pay from five to thirty dollars to get those fish planted on the spawning grounds. Now, what are you going to say to this? I speak to you warmly, because it seems to me this is a matter of great public concern. I say to you it is a calamity to destroy the hatcheries for commercial fish such as Michigan has, simply because sordid men do not want to be interfered with; simply because they say if we can only get rid of the Michigan Fish Commission, we are at liberty to work our pleasure on these fisheries. That is the position, baldly stated, that we have to

confront. For fifteen years of the best activity of the men I see about me here, we have devoted our energies and thought to building up here in the interests of the public, and incidentally for the benefit of the fishermen, one of the largest whitefish and lake trout hatcheries there is in this country to-day, and now we see it destroyed because the fishermen do not want to be controlled.

The greatest loss is sustained in the taking of small fish. As I said before, fully one-quarter in weight of the catch is of young fish, too soft and immature to be shipped to market fresh, and they go into the herring catch and are sold for a cent a pound. If those fish were left in the water for three years they would sell for three or four cents a pound at the lowest price, while they now sell for about one and a half cents per pound. Now, that is of concern to the public, not only in Michigan, but in every other state on the lakes, and this attempt to ruin an industry of this kind should be stopped.

Mr. Nevin: We have eleven tugs fishing in our waters. There are three hundred miles of nets out in that lake there every day in the year.

Mr. Tomlin: Twelve years ago, I moved before such a body as this a resolution that we ask the society to go to work and secure proper protection. The chairman that year, and the gentlemen who has recently presented his resignation, one of the members of this society, fought that resolution to the bitter end, and it was only when I appealed to such men as Dunning, of Wisconsin, and Fairbanks, that power was given that association to act. I helped to secure the first ten thousand dollars that went towards the Duluth hatchery. From that time on the interest at Duluth, and I will say on Lake Superior, has increased in fish culture. I can only regret that I have aroused so much opposition, yet I am very glad indeed I brought this matter up for discussion to-day. Mr. Whitaker has certainly given me some facts I will carry home with me. The record on my books shows since 1886 there has been an increase in the meshes of nets in Minnesota. They run from four-and-a-half-inch mesh up to five inches. The majority of the fishermen on the lakes are fishing with four and three-quarters and five-inch mesh, and I honor A. Booth & Company, and I want to tell you, gentlemen, that they absolutely and positively refused to buy any whitefish of less than two pounds dressed weight.

I think the very action taken by this Society to-day in its meeting calling for a committee to be appointed from each of the States for the consideration of this question is going to solve the whole matter, and this Association will still take the lead and recommend to the Legislature of each State something that will prove a solution of the whole matter.

Mr. Whitaker: I want to say one word in that connection. Perhaps Mr. Tomlin did not know it, but along last December, in the very water he speaks of, we received a report from Messrs. A. Booth & Co., from their fishery at Isle Royal, showing that two-thirds of their catch, and I am stating it safely—I think it was more than two-thirds—in weight of whitefish taken were No. 2's and under—fish that had never spawned in the world. It was their own man who made the report and sent it in here.

Mr. Nevin: They do not give you the full report of the amount of fish they catch, anyway. A year ago I saw a statement, which they showed to me, saying that this is for you to use and nobody else, and it differed materially from their published reports.

President: While we are on this general subject of the protection of the fisheries, we will have read a paper from Dr. Bushrod W. James, on State Laws for the Uniform Protection and Propagation of Food Fish.

STATE LAWS FOR THE UNIFORM PROTECTION AND PROPAGATION OF FOOD FISH.

By BUSHROD W. JAMES, A. M., M. D., Philadelphia, Pa.

The extended superficial area of the United States, with its waterways permeating far into the interior, from the Atlantic to the Pacific Ocean, and the Gulf of Mexico, warrants the protection of these streams to prevent the annihilation of the fish, as well as for their extended propagation and growth, as very great values may be obtained in a few years by the operation of judicious and well-considered legal enactments for the protection of the streams in which the fish are placed when very young, and for clearing and keeping clear these streams from all devices which tend to the capture of the fish before they have had opportunity of spawning in the waters which they frequent.

Most of the States into which streams enter from the ocean have already passed laws looking to this need, and New Jersey and Pennsylvania, being border States of the Delaware River, many years ago entered into a compact to protect the stream in this manner, and keep it an open waterway or highway, and as a result the money value of the fish caught in that river is increasing annually many thousands of dollars. The Susquehanna, which passes through Maryland and into Pennsylvania, has not as yet received the ample protective laws needed, and the result is that the money value of the food taken in the way of fish from that stream has been at a standstill for years and, in fact, has been diminishing in value.

The Delaware River rises well up in the interior of the State of New York, so that we have the States of Delaware, New Jersey, Pennsylvania and New York all interested in this valuable waterway. What is said of this eastern stream might be said of western rivers flowing into the Pacific Ocean, and we might likewise add the great aqueous artery of the continent, the Mississippi, and its branches, which, no doubt, might contain many million dollars' worth more of food fish than they now do; and yet, each State having the right to make fish-protective laws, might find the laws quite annulled by other States through whose borders the streams pass, the more northern States being at the mercy of those far down the river whose laws are not enforced,

and where money can be made by catching food fish in great numbers for the market, to their probable annihilation in a few years.

We could hardly expect in the rapidly flowing streams of the mountain regions of the far West to successfully protect a very great variety of the food fish; but even those should be thoroughly protected by adequate statutes by the Legislatures of the States through which these mountain streams run. Many lakes, however, occur in some of these States, even in the mountain sections. These should be protected, and not only that, but they should be stocked with the best varieties of edible fish, and of the kind that will not destroy their companions.

This condition of things existing in almost every State of the Union, it will readily be seen how great the need is for uniform laws for food-fish protection throughout the entire country.

I would here urge that this national society, composed of Fish Commissioners and members from the various States all over the country, consider well this subject of legislative action to this end.

The resolution we adopted last year, aiming at the harmonious action of each State with its neighbor in the interests of general propagation and protection, was in the right direction, and any action from that committee should be supplemented by a general support on the part of the American Fisheries Society.

I do not mean to exclude the interests of the Great Lakes during the past few years for propagation purposes, and with partially good results; but they can never carry out the full intent of those who have the general good of the community at stake in this matter of supplying a most valuable and delectable form of diet for the towns and cities where a market can be had for this form of food.

Good laws should be enacted all along the Great Lake bordering States, and they should be thoroughly enforced and a rigid observance of them continually maintained; and under no circumstances should the small fish be caught before they are of a size to have spawned at least once.

By this method an amply sufficient supply of growing fish would constantly fill the waters of the Great Lakes along our northern border. Canada should unite with the United States at all points to help fill the lakes along her shores, and by this mutual action her revenue from this one source alone would be greatly increased, as well as that of our own States.

Nothing but good can be obtained from a uniform, harmonious protection maintaining all interests in this way. In this age the depredating, contentious, "grasp-all-you-can" principle should be relegated to oblivion, and unity of purpose will redound to the mutual advantage of all parties living along the borders of these great international highways and receptacles for food-fish supplies. Kindness and mutual reciprocity usually work to the advantage and interest of all parties concerned; and in this matter, if in no other article of commerce, we should aim to obtain these uniform concessions on the part of all States and countries adjoining each other.

In regard to uniformity of laws for the streams running into the interior of the country from the large sea, lake or gulf areas, I believe that the United States Government should formulate a protective plan of extending not only over the commercial end of the streams, but that laws protecting the tributary divisions of those streams should be passed, and the enactments kept fully operative. I maintain that there is strong ground for governmental supervision of these waterways, inasmuch as the local laws of one individual State cannot be enforced in the adjacent commonwealths, and the great difficulty which has existed and which it is almost impossible to overcome, as to how these various State enactments can be made entirely harmonious and uniform, it seems quite a necessity to resort to the method of inter-state protection by national enactment, and especially over all the national waterways.

I would like to impress this point still more forcibly from another standpoint, and that is that it is the duty of the government to do all in its power to advance the interests of the citizens of the United States, and enact laws which will be for their general good, and add to the prosperity of the country. The addition of many million dollars' worth of food in this shape to the country is certainly not only laudable, but it is quite important for the government to provide this increase of provisions, and the increased value which would thereby be secured.

These laws should be enacted at a very early day likewise, because of the reckless impoverishment which is going on all over the country, in this as well as in various directions, such as forestry interests and the valuable land grants which the government and the people have so lavishly turned into the hands of reckless speculators.

It is not too late to reform this matter, and measures should at once be instituted for the uniform codification and adoption of

the best laws that can be thought out and worked out upon this interesting, important and urgent question.

DISCUSSION.

Mr. Post: Mr. President and Gentlemen: There was one thing in the paper just read to which I wish to call the attention of this association. One of the suggestions made is that we attempt to protect these fisheries by United States enactments. Now, that is throwing away your powder. In the first place, it has been determined over and over again by the courts of the states and by the Supreme Court of the United States, as was clearly shown in the case of the menhaden fisheries abuse, that was before Congress for some years, that the United States Government has no jurisdiction over those waters. The fisheries along the lines of the states belong to the states themselves, and what protection you get you must get from state authority. It is useless to waste your powder in an effort to do something which cannot be effectual when it is done. The effort was made by the menhaden fishermen in Congress to have such a statute passed, because they thought if they had that matter placed in the hands of the United States Government, that protection would not protect, and they did it to get rid of the enforcement of protection by the State governments. A gentleman from Massachusetts, a lawyer, took great pains to present the matter, and the Massachusetts Commission, at their own expense, before the congressional committee, had long briefs on the subject; so there is no doubt about it at all. Whatever action this body may take with reference to protection, let them take it in the states, and participate in inter-state conventions, where you can endeavor to get uniform enactments from the adjoining States. You will waste your ammunition by trying to get any United States protection. They have no power to do it if they undertook to do it.

There is another thing in this connection which I had in mind to say, while the discussion preceding the reading of this paper was going on. One of the things advocated was that the fishermen should impregnate the eggs of the fish on their boats and scatter them in the water; and that was suggested by Brother Nevin and sanctioned by some of the others. I know that with many men of experience and with many fish culturists it has been a favored notion, and it was one I had at one time, but I had it taken out of me by scientific authority—that is, that a very small proportion of the eggs that were cast by fish naturally were fer-

tilized. In the course of my presentation of the advantages of artificial propagation, I used to make that argument. I used to give the percentage of eggs hatched that we took, and compare them with the probable percentage hatched naturally, and then give the percentage of success in our favor. I made that proposition once in Prof. Reighard's presence—I am sorry he is not here now—and he told me I was probably very largely mistaken in that regard. Of course, he had not experimented with whitefish eggs, but he had with many other eggs, the eggs of reptiles and other fish, and he said the probability was that most of the eggs that are cast by the female were fertilized naturally. The loss does not come from lack of fertilization, but from the destruction of the eggs after they are fertilized. So you see this has an important bearing on the question of the fertilization of fish ova and the benefits and advantages of stripping fish and fertilizing the eggs on the fishing grounds and then throwing them overboard; and it especially has an important bearing upon the value of the fishermen fertilizing the eggs as they catch the fish.

Of course, Mr. President, one statement that Brother Nevin made is rather extravagant. He did not mean it in quite the sense he states it, that not one egg in a million is fertilized by natural methods. As you know, the average of eggs in one whitefish is twenty-five to thirty thousand, and if what he says were so, it would take a great many whitefish to get one egg fertilized. He only meant that figuratively.

Mr. Nevin: I only intended to give a general idea of that.

Mr. Post: My judgment is that the benefit of artificial propagation largely comes from protecting the eggs from their multitude of enemies and carrying them through the period of incubation safely and delivering them as live fish instead of dead eggs into the water. I never believed in the advantage or utility of having the fishermen on the tugs attempt to strip the fish, impregnate the ova and deliver them into the water. I have always looked upon that argument as an excuse to get rid of the hatcheries—as a scheme to antagonize the hatcheries. It has generally, where I have heard it proposed, been proposed, as I thought, with that view. It has a very plausible appearance of advantage to an economical legislature, that instead of the great expense that was laid out in these hatcheries, we might for a very little money get the same results by having the fishermen strip the fish and plant the eggs. I do not believe in it. I do not believe it is of any

advantage, and I am pretty well aware, too, of what Mr. Clark said in that connection, that there were very few fish caught from tugs that were ready to be spawned.

At this point Governor Pingree entered the room, and was warmly received by the convention.

Governor Pingree: Don't stop on my account, gentlemen. Keep right on fishing. That is all I can say.

The Governor was invited to address the society, and spoke as follows:

Governor Pingree: I am sorry I could not have met with you yesterday and last evening. I hope you all had a good time. There is room for lots of work in this cause, and I am satisfied that this gentleman here (referring to Mr. Whitaker) could give you all the information that anyone could give from Michigan, else I would have been with you. The fact is, that very few people in Michigan realize how much they lose in not looking after the lakes and in not looking after the fish of Michigan. (Applause.) I am satisfied that you gentlemen are taking an interest in that industry. As I have said, we do not realize how much we lose by not looking after that industry, and nothing pleases me any more than to see you gentlemen interested in this matter.

I did not think of saying anything, but I will say this: When I was first elected Governor, I intimated, and I may say I thought I would make a tour around the lakes and meet every Governor that was about to be elected and see if we could not get them interested in the fish business; but something came up, and I found it was a bigger job than I was able to manage, and so I did not make that trip; but I assure you that it is a grand work, and there is lots of room for work. The people need to be educated in regard to your work. That is what we are in favor of—education.

I thank you for your attention, and, as I say, I am satisfied and know our commissioner here has his heart in this work. I think if he sends up any prayer, he certainly remembers the fish every time. I thank you, gentlemen.

The Chair: Mr. Post, you can resume where you left off.

Mr Post: I can hardly tell where I left off, and I had but a few more words to say. Of course, it seems to me that this general proposition that the provisions of nature for the fertilizing and hatching of whitefish, if they are as faulty as one would be led to believe by the expression that not one out of a million eggs

is fertilized, is contrary to all other rules of nature, and we some of us know by actual experience it is not so.

In this connection I would like, while I have the floor, to offer a resolution, which I hope will meet the views of the association. It has a bearing somewhat on the line of our discussion, and I may not have another opportunity to present it.

Resolved, That the American Fisheries Society learns with sincere regret of the deplorable action of the Legislature of Michigan, at its recent session, in so cutting down the appropriations to the Michigan Fish Commission as to seriously cripple the great work it had undertaken and had so well in hand, of restoring and building up the commercial fisheries of the Great Lakes.

Taking into consideration the extensive operations which that commission has carried on for several years, this Society regards such action as a matter of more than mere local interest, and of general public concern, from the tendency to discourage legitimate appropriations to such work in other States, and to dishearten fish culturists everywhere.

We sincerely trust this false economy will be of short duration, and that with the anticipated coming of better times liberal appropriations will again be granted for the purpose of carrying this great undertaking to a successful issue.

Mr. Post: I move its adoption.

The motion was duly seconded and unanimously adopted.

Mr. Clark: There is just one thing I want to bring out in regard to the impregnation of the egg in reply to what Mr. Post says. I made some experiments in this connection, and from those experiments I cannot indorse what Mr. Post brings to us from Prof. Reighard I have done it with whitefish, and that certainly leads me to believe that the impregnation naturally is not very good. I think our friend, Mr. Nevin, has got it too strong altogether, but we do know it is not possible to largely impregnate the eggs in water. We now use the dry method. We know that when you take whitfish eggs in a quantity of water, the percentage of impregnation is lower, according to the quantity of water used with the milt.

Mr. Post: I guess there is no doubt about that, in artificial propagation.

Mr. Clark: If there is no other reason why spawning under natural relations would give us a lower percentage of impregnation, certainly the reason of spawning in open water, where the

milt is diluted, would show to us that the impregnation would be quite low, and therefore I cannot see, with the whitefish especially, how the impregnation of the egg would be very high, from that fact. Of course bass make their nests and spawn right in that locality. With whitefish, I do not know but someone is prepared to say just how they spawn, but I am not; but it is probable they spawn something after the manner of the shad, and the shad do not make nests. I have seen shad in the act of spawning, and they spawn and throw the spawn in open water.

Mr. Nevin: Mr. Post does not believe that the impregnation takes place when they throw them overboard off the boat. I can name two grounds—one is at Whitefish Bay, Lake Michigan—used to be fished by Mr. J. P. Clark, of this city. It is practically fished out now. We went on there to plant fish, and the third year there was as high as four thousand pounds taken at a single net. Another point is up at the mouth of the Sturgeon River, and that has failed in within the last twenty years. We have planted overboard there, and it has accomplished great results.

Mr. Whitaker: Let me ask you a question? Where was this?

Mr. Nevin: On Lake Michigan, at Sturgeon Bay.

Mr. Whitaker: Were there any plants of fry made in that vicinity?

Mr. Nevin: Not a fry ever planted there.

Mr. Whitaker: Your commission never planted any on that coast?

Mr. Nevin: No, sir, we never planted any there.

Mr. Bower: I was going to say, that I think on both sides of this question you are going a little to the extreme. I believe where the egg and the milt come in contact, fertilization ensues almost instantaneously, or in a very brief period at least. If the egg and the milt are brought into contact while the spawning process is going on, the eggs must necessarily be fertilized, but when we consider the way in which the fish spawn, naturally, it would seem that a good many eggs are not thus brought into contact with the milt, particularly in a current. The brook trout make a bed and they spawn in the current, where much of the milt is diffused and wasted. But admitting everything that Mr. Nevin says to be true, why not go one step further and save where the great loss occurs? We

know these spawning beds are ravaged during the entire season. They are exposed for a period of four to six months, according to the locality, to all kinds of depredations and all kinds of spawn-eating fishes. We would certainly save that, besides the increased percentage of fertilization.

Mr. Davis: I think there is a mistaken idea in regard to the impregnation of eggs in water. We know by actual experience with some fish, at least, there is a large percentage of impregnation in the water, and even in a small current. You take the black bass, in our experiments during the last two or three years, we know by actual experiments that a large proportion of those eggs are impregnated in water. In my opinion, the destruction of the eggs by their natural enemies instead of lack of impregnation. is the reason your results may be so small. Mr. Bower will remember that last spring, in our little pond at Cascade, where we conducted our experiments, we got as high as ten thousand black bass from one pair of fish, estimated. And this is natural impregnation in water. About five thousand bass to each pair, and it strikes me that that in a measure destroys the theory that the eggs will not impregnate in water.

Dr. Parker: I wish to call attention to the fact that we are digressing entirely from this paper.

The Chair: That is true, but these subjects are so intimately related, and the discussion is so interesting, it seems to me very practical, and we will not draw the line as closely as we would otherwise. Mr. Post desired to say something upon that other matter, and he was given permission.

Mr. Nevin: In the fall of 1868 and '69 salmon used to run up the Salmon Creek, on Lake Ontario, by the thousands. We put up a shed there 80 feet long and 30 feet wide, turning the stream practically through the shed. We went to work and built racks about four feet wide and laid them along the width of this floor, and put in wire screens. We thought by allowing the salmon to go on spawning naturally we would get better results. We let the spawning end, and we did not hatch one per cent. It was practically a failure to allow the fish to spawn naturally in that water.

Dr. Parker: Since the discussion has taken this form, I would like to say this: That nature in her wisdom always provides for the continuance of the species, and in those animals—notably the fish—where the destruction of the eggs and young is

necessarily very large through their environment, she produces the ova in enormous numbers; for instance, the sturgeon will deposit a million or more and only a few are fertilized, and but fewer still reach the adult form; and so with the codfish, and other forms of sea fish; and the whitefish. The whitefish yields a large percentage of eggs in proportion to the size of the fish. Mr. Davis speaks about the black bass; the eggs are few in comparison with many other fish, but the environment is such that the fertilization is large, and as the black bass protect their eggs, the percentage of young is large. And this law holds good through all forms of animal life, insect life, even plant life; we know that millions of spores of pollen are thrown off; that one seed may be fertilized.

Mr. Post: One seed is the egg.

Dr. Parker: Yes, but it takes millions of good sperms that one egg may be fertilized. When nature furnishes a comparatively small number of eggs, a large number are fertilized, and vice versa; so that the balance is pretty well kept all the way through. What Mr. Davis says about the spawning of bass in still water is correct, and the fact that they did in one instance get ten thousand fish from a single bed in the pond, and the further fact that some beds in the pond averaged a good deal higher—that is, produced a larger number of fish than the beds in the river—show we get a greater percentage of fertilization in still water than in running water.

Mr. Davis: My remarks were made in answer to the remarks by Mr. Clark about eggs not fertilizing in water.

Mr. Clark: No, no, you misquote me. I trust the members will not misunderstand me. I do not claim at all that eggs cannot be impregnated in water. It is not that; but the more water you have, the greater the reduction of the milt power. Don't you see? It is scattered. When you take them in the dry process your eggs are in nothing but the milt, and of course the milt is right around them. If you have a barrel of water and one male fish, the milt is diluted. That is what I wanted to say, not that you cannot impregnate in water.

Mr. Stranahan: I have observed the spawning beds of black bass under very favorable circumstances, where the fish were at home, and I have used marine glasses so their operations could be watched, and at the instant those eggs are dropped there is a flow of milt from the male and they are immediately together.

You can see the eggs drop and you can see the milt spurt out from the male, and I think that accounts for the large percentage of impregnation of black bass. We think they impregnate 95 per cent. of their eggs, while with the whitefish the percentage is very small. The two fish will swim along through the water, casting their eggs and their milt simultaneously.

Dr. Parker: I think Mr. Clark said that he did not know the method of spawning of the whitefish—that he had never seen it. I saw it down here at the Fort fishery once. I was there one fall, and I have every reason to believe it was correct. The fish were spawning in the pond. The male and female came up like this (indicating), rising up nearly to the surface together, with milt streaming down and the eggs from the fish being extruded.

Mr. Clark: Did you see the milt and the eggs?

Dr. Parker: I saw that motion, and the two fish were together, and I have every reason to suppose that it was the act of fertilization.

Mr. Bower: A great many fishermen have theories as to how whitefish spawn. When whitefish spawn, they spawn at night almost entirely, and they can be seen jumping out of the water. Their theory is that they start from the bottom and rush towards the surface, and of course they are making such rapid headway that they fire themselves out of the water. Then, of course, they separate and drop back right close together—the two bodies close together. They go up at an angle through the water until they jump up out of the water.

Dr. Parker: That is what I saw out there.

Mr. Titcomb: I will verify the statements of these two gentlemen. In my operations for the collection of fish, I saw the operations of the fish. They had selected a ledge close to the shore, where the rocks went off abruptly, and I had those lights which I described in my paper, so that I could watch them closely, and the two fish would swim along side by side, rubbing their sides together, with an upward movement through the water. I did not see them jump out of the water, but I could not see the spawn.

Mr. Whitaker: As to impregnation of eggs, I don't believe anyone in the world knows the number of eggs naturally impregnated. It is impossible. A man may make an investigation of certain eggs under certain circumstances, but they may be en-

tirely unlike those that occur in the natural water. What the gentlemen don't want to lose sight of is this question of the fishermen stripping eggs and returning them into the water. On that I take the same position that Mr. Post has. I know it is an argument which has been raised against artificial propagation, for the purpose of discouraging and discrediting our work. That has been one of the subterfuges that has been used. I will not go to the extent of saying I don't believe it ought to be done; but you cannot speak of it in the same breath as you can of the artificial propagation of fish. It is one of the singular things in human experience, and I don't believe there is another instance where artificial means have discounted natural means in their results as in fish culture. What does it mean? It means simply this: that if you take the eggs of the salmonoids, which are easily handled, and impregnate those eggs and get upwards of 90 per cent. as we do, it is not an exception. There is no question but that you have largely increased Nature's ways of doing it in the matter of impregnation. That is not the end of it. That is the beginning of artificial impregnation. The great advantage in natural impregnation is that you isolate the eggs from their enemies until they are born fish. That is where you get a great advantage. The fact of the matter is, when an egg is cast on a natural spawning bed—I don't care whether it is in a stream or the great lakes—that egg is absolutely helpless—it is unprotected. The storms of winter come and stir up the silt from the bottom of these immense seas, and a good proportion of these eggs are covered with mud. In addition to that, if there is a choice viand for any fish, it is the eggs of its own or the eggs of some other variety of fish. You isolate the ova in artificial propagation from their enemies, and that is where the great percentage of gain is made by artificial means.

I would not discourage the idea of impregnating them and putting them back, although I don't think there is a great deal gained by it. Instead of having those eggs thrown away, if you only get five per cent. of impregnation, you have gained that much; they have not gone absolutely to waste.

In this matter of natural impregnation of eggs, I hold with Mr. Clark, and with some of the other gentlemen, and it seems to me that the discovery of Vrasski and Seth Green—a re-discovery, perhaps, by an independent observer of the process of dry fertilization of eggs shows a great improvement over natural methods. Mr. Green once told me that in the beginning, when he began to strip fish, he only got an impregnation of about 25 or 30 per

cent. He then said to himself, if something better than that could not be done we might as well quit the business. I inquired of him how he came to settle upon this question of dry impregnation. He said he reduced the amount of water gradually, and when he got it down so as to have enough to just free his eggs from the pan, he brought his impregnation up to nearly 100 per cent. There is no question in my mind—I know it from reasoning by deduction—I know it in no other way—that the very idea in nature of making fish so prolific was the idea that a large percentage of ova was lost, but if it were not for the interference of man, the stock would be maintained even in the way nature provides.

Mr. Bryant: I desire to offer the following resolution:

Resolved, That the warmest thanks of this Society be extended to the Hon. James McMillan and Mr. M. S. Smith, of Detroit, to the Lake St. Clair Shooting and Fishing Club, and to the anglers of the City of Detroit, to the officials of the Michigan Central Railroad, and the press of Detroit. Their courtesies, hospitable entertainment and kindly attentions have added to the pleasure of our meeting, and made our visit one to be cherished among pleasant memories.

I move the adpotion of the resolution.

The motion was unanimously adopted.

On motion, the Society then took a recess until the following day, the meeting to be held at the Paris, Mich., hatchery.

On the evening of the 18th the Society took a special train of private cars, as the guests of the Michigan Central Railway Co., and were taken to the Paris hatching station of the Michigan Fish Commission, some two hundred miles from Detroit, returning to Detroit the evening of the day following.

The Society then adjourned until to-morrow.

PROCEEDINGS OF SATURDAY, JUNE 19, 1897, AT THE SESSION HELD AT PARIS, MICH.

President: The first business in order is the reading of a paper by Mr. James Nevin, of Wisconsin, on Pike Eggs.

Prof. Birge: I wish to say that this is a portion of the report of Mr. Nevin, which was submitted to the Wisconsin Board, and relates to the loss of pike-perch eggs after they had arrived at the eyed condition, and we thought it might possibly be of interest to the Society.

The paper was then read by Prof. Birge, as follows:

WALL-EYED PIKE.*

By JAMES NEVIN, of Wisconsin.

Some 190,000,000 wall-eyed pike eggs were collected this year during the spawning season. The pike eggs are the most delicate eggs with which we have to deal. It is seldom that the fish culturist succeeds in impregnating more than 50 per cent. of the eggs he takes.

We were very successful this year in securing male fish with which to impregnate the eggs, and with our improved methods of caring for the eggs during the time of taking them, we ought to have had 100,000,000 fry to distribute. The eggs cleaned up in the very best form. After they had been in the jars some thirty days, and the embryo was well advanced, they began to die in the hatching jars, and have died off in such large numbers that we will not have over 30,000,000 fry to distribute.

In my report to the Commission last winter, I recommended that a cheap hatchery be built at Oshkosh, where the water in which this fish hatches naturally can be had for hatching purposes. I am satisfied now, that if we had built such a hatchery this spring, we would have had over 100,000,000 wall-eyed pike fry to distribute.

Last year was the first instance in which we have had any pike eggs die in the jars at the Milwaukee hatchery, after the eye of the fish was discernible. In previous years the loss of eggs occurred in all cases before the eggs had reached that stage in which you can distinguish the eye of the fish in the egg. Such losses, I have always held, were due to the scarcity of male fish, or that the milt from the males—which were always undersized—was not of sufficient strength to produce strong and healthy impregnation. This year we had an abundance of excellent male fish, and many more than we required; and the results, so far as fertilizing the eggs was concerned, was very satisfactory, as experiments made at the time the eggs were taken fully demonstrated. In these experiments we held the eggs of the pike in the river water, from which the parent fish were taken, for fifteen days, and we had no loss with the eggs.

* Extract from Report of Superintendent James Nevin to the Fish Commissioners of Wisconsin, dated June 15, 1897.

The cause of the loss of pike in the egg stage at Milwaukee I attribute to the low temperature of the water. Some two years since the Milwaukee water works began to take their supply of water from the new intake, and the temperature of water which we now get for hatching is much lower than in past years, so low that the fish will not mature as quickly as they should, but die in the egg. At no time this spring has the temperature of the water gone above 48 degrees Fahrenheit, which is the usual temperature of spring water in our State.

Twelve years ago I attempted to hatch pike eggs at the Madison hatchery in water drawn from one of our ponds at a temperature of 50 F., but the fish began to die in the eggs as they did at the Milwaukee hatchery this spring. At that time I fixed up a temporary place below the mill dam on Lake Mendota, transferred the eggs to this improvised hatchery, and thus saved the year's hatch.

At the next meeting of the Board I hope to be able to advise the Commissioners as to what can be done in the way of securing water and a site for a hatchery at Oshkosh for hatching our pike eggs in the future.

Following the reading of the paper a discussion was held upon the paper, which was participated in by Mr. Clark, Mr. Titcomb, Prof. Reighard, Mr. Bower, Prof. Birge and Mr. Nevin, and others. There being no stenographer present, the discussion does not appear.

Mr. Titcomb moved to reconsider the motion by which the Society yesterday directed that five copies of the proceedings should be given to each member.

The motion was supported, and being put, was carried.

President: The motion has been reconsidered and is now before you for action. What is your pleasure?

Mr. Titcomb: I move the Secretary be directed to have printed five hundred copies of the report.

President: It is understood, of course, that these reports are not for general distribution, but if members desire additional copies they can undoubtedly be had.

Mr. Titcomb's motion was supported, and being put, was carried.

On motion, the Society then adjourned.

FEEDING TROUT FRY, OR THE FOOD PROBLEM SOLVED.*

By S. E. LAND, Wyoming Fish Culturist.

To begin the process of providing food for fishes, we should first look into nature's mirror; what kind of food is most natural to the fish which we have in hand. Next, what are the temperatures of water most suitable to the habitat of such fish. Let us take for example the young trout, salmo fontinalis; while this fish is developing from sac stage to feeding stage, say in water at 45 degrees Fah., when the sac on these fish is one-third absorbed, just before they begin to scatter, they will take very fine food if fed little and often during the day. In nature we find these small fish feed in that way and they do survive if planted in water where insect life is known to abound, and temperature of water is below 60 degrees. In order to come as near as possible with artificial food, to that which is provided by nature, we take the animal food and prepare it as fine as flour, then mix it with water and feed it in a diluted form to the fry impounded in the hatchery troughs. When fry are removed to the nursery ponds, this fine food should be furnished from first to last or until fry are fingerlings. The food problem is then solved and the result is no loss from starvation.

The most natural food is fish flesh, suckers or any inferior fish can be fed to trout. To prepare such food for fry, to save labor and get the best results, fish should be taken without dressing and be cut up so they will go through a meat cutter, then of this ground fish flesh two-thirds should be placed in a tin milk pan with one-third water and baked in an oven until the water is evaporated and the fish flesh is done thoroughly; then put this cooked fish flesh through the meat chopper again, this makes a paste, and if not fine enough, you can grate it through a fine sieve, but it must be as fine as flour when you mix it with water to feed to your small fry. You can do this with liver and get good results, but the fish flesh with this pulverized and cooked fish bone in it, is more natural and more beneficial to the young trout.

* The following paper was received too late to be read before the Society, but is published as a valuable contribution to the subject of which it treats.

During the whole time you feed, be sure that the whole surface of the water is covered with this mixture of fine food, then you will know that all fry in your troughs have had some food at each feeding. To feed fish at head of troughs and expect those at lower end will come up to feed, is folly. Once a trout is off its feed it will not come for the food thrown in a pond or at head of trough, but there little weaklings will literally starve to death, as thousands of them do at most every hatchery institution.

The next thing to be done is to thin out from troughs to nursery ponds and to feed properly there. You should have water falling into your ponds in at least a dozen places, say through small open tin spouts on each side and upper end of your ponds. You will find thousands of fry at all times under these spouts, that should have a 6-inch fall to aereate water; there the fry stay and watch for food. When you pour in the liquid food at intake of your ponds, it flows out through these spouts and all fish in nursery ponds get fed, otherwise starvation and death are the results.

When it is possible keep young trout in spring water, that never is at a higher temperature than 50 degrees Fahr., but any water from 40 degrees to 50 degrees is excellent. After trout are six months old or yearling and adult trout, water from 50 degrees to 60 degrees will cause no mortality; but plenty of food and plenty of running water is absolutely necessary to get the best results.

I do not believe in forcing the growth of the trout, like one man I found at Caroline, R. I., who refused to show me his ponds or trout for fear I would infringe on his right of rapid trout production. He said: Sir, I can grow trout so fast that I can get the eggs from my fish and get them on the market as long yearlings and make them weigh three to the pound; that beats selling your two-year-old trout that the other fellow raises and has to put in four to the pound." But when I asked that man if he sold all his trout as long yearlings, if there was not danger of him selling himself out of business. He replied that he forced the eggs to grow in the fish by the time they were one year old. This beats the growth of trout on natural food, which abounds in the waters of the Big Horn Mountains, and creates a growth of trout of one pound to the year after they are two years old.

For the past four years I have had better results in feeding cooked food to trout when prepared very fine, than I ever did in feeding raw liver that bleaches out and swells when put in water; also fouls the water in troughs when fish do not eat it. Whereas cooked food is always eaten by the fish when finely pre-

pared and fed in diluted form, and fish are fed from four to six times a day.

There is only one way to solve the food problem, and that is to give your fry and adult fish plenty of food and plenty of water. Avoid overcrowding in rearing, and overcrowding in shipping, and last but not least of all it is essential to handle all trout and young fish in cold water, and if fry are shipped in water below 40 degrees in refrigerator fish cans, there is absolutely no loss in transportation at any season of the year.

CONSTITUTION.

ARTICLE I.

NAME AND OBJECTS.

The name of this society shall be American Fisheries Society. Its objects shall be to promote the cause of fish-culture; to gather and diffuse information bearing upon its practical success, and upon all matters relating to the fisheries; the uniting and encouraging of the interests of fish-culture and the fisheries, and the treatment of all questions regarding fish, of a scientific and economic character.

ARTICLE II.

MEMBERS.

Any person shall, upon a two-thirds vote and the payment of three dollars, become a member of this society. In case members do not pay their fees, which shall be three dollars per year, after the first year and are delinquent for two years, they shall be notified by the treasurer, and if the amount due is not paid within a month thereafter, they shall be, without further notice, dropped from the roll of membership. Any person can be made an honorary or a corresponding member upon a two-thirds vote of the members present at any regular meeting.

ARTICLE III.

OFFICERS.

The officers of this Society shall be a President and a Vice-President, who shall be ineligible for election to the same office until a year after the expiration of their term; a Corresponding Secretary, a Recording Secretary, a Treasurer and an Executive Committee of seven, which with the officers before named shall form a council and transact such business as may be necessary when the Society is not in session, four to constitute a quorum.

ARTICLE IV.

MEETINGS.

The regular meeting of the Society shall be held once a year, the time and place being decided upon at the previous meeting, or, in default of such action, by the Executive Committee.

ARTICLE V.

CHANGING THE CONSTITUTION.

The Constitution of the Society may be amended, altered or repealed by a two-thirds vote of the members present at any regular meeting, provided at least fifteen members are present at said meeting.

LIST OF MEMBERS.

ACTIVE.

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